TRANSACTIONS

OF THE

ILLINOIS STATE ACADEMY OF SCIENCE

VOLUME 27 DECEMBER, 1934 NUMBER 2

Papers Presented in the Twenty-seventh Annual Meeting, Decatur, Illinois May 4 and 5, 1934

EDITED BY DOROTHY E. ROSE

Printed by authority of the State of Illinois
DEPARTMENT OF REGISTRATION AND EDUCATION
STATE MUSEUM DIVISION, CENTENNIAL BUILDING
SPRINGFIELD, ILLINOIS

PUBLISHED QUARTERLY

Entered as second-class matter December 6, 1950, at the post office at Springfield, Illinois, under the Act of August 24, 1912.

STATE OF ILLINOIS
HON. HENRY HORNER, *Governor*

DEPARTMENT OF REGISTRATION AND EDUCATION
HON. JOHN J. HALLIHAN, *Director*

STATE MUSEUM DIVISION
ARTHUR S. COGGESHALL, *Chief*

ILLINOIS STATE ACADEMY OF SCIENCE
AFFILIATED DIVISION OF THE
STATE MUSEUM

OFFICERS FOR 1934-35

President, Charles H. Behre, Jr.,
Northwestern University, Evanston, Illinois

First Vice-President, Charles D. Sneller,
Peoria, Illinois

Second Vice-President, L. K. Wright,
Bloomington High School, Bloomington, Illinois

Secretary, Laurence L. Quill,
University of Illinois, Urbana, Illinois

Treasurer, George D. Fuller,
University of Chicago, Chicago, Illinois

Librarian, Arthur S. Coggeshall,
State Museum Division, Springfield, Illinois

Editor, Dorothy E. Rose,
State Geological Survey, Urbana, Illinois

Council: The President, First and Second Vice-Presidents, Secretary, Librarian, last two retiring presidents, and the retiring secretary.

PRINTED FEBRUARY, 1935

7

(41072)

TRANSACTIONS OF THE ILLINOIS STATE ACADEMY OF SCIENCE

Volume 27 December, 1934 Number 2

CONTENTS

PAPERS IN ANTHROPOLOGY

PAGE

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 51
MERWIN, BRUCE W.—Archaeological Reconnaissance Work in Southern Illinois, 1933 53
NEUMANN, GEORGE K.—Earliest Inhabitants of Illinois 54
SIMPSON, ANSON—Kingston (Illinois) Focus of the Mississippi Culture .. 55
VOSS, JOHN—Prehistoric Timetables 56

PAPERS IN BOTANY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 57
BILLS, ROBERT W.—Barberry Eradication in Illinois 59
GALLIGAR, GLADYS CHARLOTTE—Some Bryophytes of Macon County, Illinois 60
HAGUE, STELLA MARY—Mosses from the Illinois Ozarks 62
NOÉ, A. C.—New Methods in Paleobotanical Micro-Technique 64
TANNER, FRED W., AND BYERLY, J. ROY—The Effect of Ultra-Violet Light on the Fermenting Ability of Yeasts 65
VOSS, JOHN—A Stratigraphical Study of the Manito Swamp 66

PAPERS IN CHEMISTRY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 69
GETZ, C. A., WITH SMITH, G. F.—A New Aeration Process for the Preparation of Whipped Cream 71
HARRISON, H. E., WITH ENGLIS, D. T.—The Occurrence of a Pectin Material in Artichoke Sirup 73
PAGE, J. O., WITH ENGLIS, D. T.—The Effect of Potassium Cyanide upon Amylase Activity 74
STEGEMAN, R. A., WITH ENGLIS, D. T.—The Use of Ceric Sulfate for the Determination of Cuprous Oxide Obtained by the Action of Reducing Sugars on Fehling's Solution 75
FRANKLIN, G. T.—A Few Suggestions on the Teaching of Fuels in Elementary Chemistry 77
NICHOLSON, D. G., AND REEDY, J. H.—Explosive Reaction of Perchloric Acid with Metallic Bismuth 78
REEDY, J. H.—The Technique of Microchemistry 79
SCHULHOF, KAMIL—Changes in the Hydration of the Serum Colloids as a General Feature of Disease 80
SEKERA, VLADIMIR C.—The Mechanism and Application of the Fries Isomerization 81

PAPERS IN GEOGRAPHY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 83
POGGI, E. MURIEL—Decatur, Illinois, A Study in Urban Geography 85

PAGE

AYRS, EMMA—The Retarded Development of Alaska 100
BLANCHARD, W. O.—Ten Points of Emphasis in the Geography of Illinois. 101
LATHROP, H. O.—Geography of the Tobacco Region of Southern Wisconsin 103
PLATT, R. S.—Items in the Haitian Pattern of Occupance 104
STEVENS, LEAH—Pattern of the Port of Vancouver, British Columbia 105

PAPERS IN GEOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 107
BEVAN, ARTHUR—Research on Paleozoic Formations in Virginia 109
BONNELL, CLARENCE—A Four-Hundred Acre Lake Disappears 110
LEIGHTON, M. M., AND EKBLAW, G. E.—Glaciology of the Decatur Region .. 111
NOÉ, A. C.—New American Plants from the Pennsylvanian Period as Preserved in Coal Balls 112
POWERS, W. E.—Effects of Barometric Pressure and Winds on the Level of Lake Michigan 113
ROE, W. B.—Clay-veins in the Springfield (No. 5) Coal 115
SAVAGE, T. E.—The Port Byron Limestone and its Fauna 116
SCOTT, E. R., AND BEHRE, C. H., JR.—Structural Control of Ore Deposition in the Wisconsin-Illinois Lead-Zinc District 117
SUTTON, A. H.—Ovoviviparous Reproduction of Miocene *Turritellidae* ... 118
THIESSEN, GILBERT—The Integration of Sciences Required for a Logical Study of Coal 119
WELLER, J. MARVIN—Boundaries of Pennsylvanian Cyclothems 121
WORKMAN, L. E.—The Subsurface Stratigraphy of the Decatur Region .. 122
WORKMAN, L. E., AND HUNER, J.—The Subsurface Stratigraphy of the Devonian in Western Illinois 123

PAPERS IN PHYSICS

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 125
KNIPP, CHARLES—A Compact Vacuum Gauge for Measuring Pressures Ranging from .2 mm. down to .0001 mm. of Mercury 127
KNIPP, CHARLES—Renewed Activity of Radium Bromide After Heating, as Revealed in a Wilson Expansion Chamber 128
KNIPP, CHARLES—Model of an Electric Cell, Simulating Ion and Electron Flow 129
BOCKSTAHLER, LESTER I.—Electron Diffraction and the Physics of Solids. 131
KUNZ, JAKOB—The Flow of Liquids Through Submerged Orifices 132
KUNZ, JAKOB—The Present Crisis in Theoretical Physics 133
LARSON, K. G.—Notes on the Foucault Pendulum 135

PAPERS IN PSYCHOLOGY AND EDUCATION

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 137
PETERSON, H. A., OBOURN, GLEN, WALLACE, HAZEL AND J. M., AND SMITH, O. W.—Relation of Scholarship during College Career to Success in Teaching Judged by Salary 139
REYMERT, MARTIN L.—Psychology and Juvenile Crime 141
SCHROEDER, PAUL L.—Psychiatry and the Modern Child 143
WHAM, GEORGE D.—Cultural Value of Courses in Psychology and Education 145

PAPERS IN ZOOLOGY

PAGE

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN 147

BALDUF, W. V.—Entomophagous Parasitism Among the Beetles 149

FLINT, W. P.—The Automobile and Wild Life 150

FURROW, CLARENCE LEE—Sexuality among Prosobranch Molluscs 154

HOHEISEL, WILLIAM F.—Skeletal Modifications in River Catfishes of Illinois 155

MATTOX, NORMAN T.—Abnormalities in the Uterine Young of the Freshwater Snail *Campeloma rufum* 156

MAUNTEL, HARRY W.—Thomas Say, Early American Zoologist of the Middle West 157

MONTGOMERY, C. E.—Biological Principles Underlying the Field of Education 159

STANISLAUS, SISTER M.—Living vs. Dead 160

STARRETT, W. C.—A Study of Characters for the Differentiation of Two Species of Minnows of the Genus *Notropis* 161

VAN CLEAVE, HARLEY J.—Seasonal Life History of a Snail of the Genus *Fossaria* 161

BIBLIOGRAPHY

VESTAL, ARTHUR G.—Bibliography of the Ecology of Illinois, Part I 163

PAPERS IN ANTHROPOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Of the six papers presented at the meeting of the Anthropology Section, only four are here represented. The others were:

"The application of the tree-ring method in dating prehistoric sites," by John C. McGreggor, University of Chicago.

"Basic cultures of the Mississippi Valley and their Illinois representatives," by Thorne Deuel, University of Chicago.

Three of the nine papers on the program were not given.

Average attendance at the meeting was thirty-five.

Bruce W. Merwin, Southern Illinois State Normal University, Carbondale, Illinois, was elected chairman of the section for the 1935 meeting.

(Signed) THORNE DEUEL, *Chairman*

ARCHAEOLOGICAL RECONNAISSANCE WORK IN SOUTHERN ILLINOIS, 1933

BY

BRUCE W. MERWIN

Southern Illinois State Normal University, Carbondale, Illinois

During the year of 1933, under the auspices of Dr. Warren K. Moorehead of Phillips Academy, some archaeological reconnaissance work was done in Southern Illinois, primarily in connection with axes and celts already collected. Of secondary importance was the locating of various forms of Indian remains and the collecting of surface material. In connection with the study of the celts and axes, sixteen collections were visited, photographed, and studied; fourteen others were visited and studied, but no photographs were taken; and twenty smaller collections are listed and may be visited later. The work included over two thousand miles of travel and the taking of over two hundred photographs. The summary of the work on stone axes has been submitted to Dr. Moorehead.

All of the study was confined to Southern Illinois, but the matter of locating and visiting sites was largely concentrated about Jackson, Williamson, Johnson, Union, and Alexander counties. As a result of the work, the following remains were located and mapped: large towns—7; village sites or camp sites—168; mounds or mound groups—42; rock shelters—28; workshops—21; "stone forts"—5; burials or burial grounds—58; rock carvings—7; limestone caves—7; flint quarries—5; salt works—3; salt licks—2; trails—3; and miscellaneous—12. Under miscellaneous is included one spring said to have been walled up with rock, and four small areas where there seemed to have been fire for a long period of time. Many of the sites were visited and collections of surface material were made.

Perhaps the most outstanding of the sites visited, and one which has probably never been reported in print, is the Kincaid group of mounds located near Brookport. This group of mounds covers an area almost one-half mile square located along the banks of Avery Lake. The largest of the mounds is about 650 feet long, 250 feet wide and 40 feet high and covers an area of approximately three acres. In shape it is described as a woman's inverted shoe. At the extreme west end, corresponding to the heel, is a sort of truncated conical mound that is about 60 feet across at the top and 40 feet high. About 20 feet lower is a small neck of land 25 feet across, which connects to the sole, which in turn is about 300 feet long, 100 feet wide at its widest point, and 15 feet lower than the heel or 25 feet above the level. Near the toe is a graded way about 40 feet wide leading down southeast toward the center of the village.

The second largest mound is about 375 feet long, 175 feet wide and 35 feet high. It has a flat top on which are located a house, barn, and other buildings. There are two large mounds of the truncated square pyramidal type about 250 feet in diameter at the base and 25 feet high, close to the others already mentioned. There are three slightly smaller mounds nearly one-half mile away at the east end of this village site. The area between has a few mounds some four to eight feet in height and 75 to 150 feet in diameter. This area also contains several large depressions and what appear to be a number of hut-rings. Northwest of the largest mound are three large depressions, the largest being over 500 feet across.

This site seems to represent the same culture as the Angel group near Evansville, Indiana, the Milligan mound in Dogtooth Bend near Cairo, and the Linn site in Union County. It should be studied more in detail, purchased by the state, and preserved as a park.

EARLIEST INHABITANTS OF ILLINOIS

BY

GEORG K. NEUMANN

University of Chicago, Chicago, Illinois

ABSTRACT

In 1930 a mound, designated as F-77, was excavated near Liverpool, Illinois, under the direction of Dr. Fay-Cooper Cole, by the field party of the Department of Anthropology of the University of Chicago. The mound had been previously excavated by amateurs and was found to belong to the Illinois Hopewell variant of the Woodland culture. Upon excavation by the field party, the discovery was made that the mound had been built over an older village site and cemetery of the Woodland culture. Twenty-six flexed or semi-flexed burials were recovered from this ancient cemetery.

The examination of the skulls indicated that the people from this older village site represented a distinct physical type, for they differed from skulls from mound burials of people of the Illinois Hopewell variant of the Woodland culture. The former were long-headed (cranial index of 72.7), with a narrow forehead, broad cheek bones and broad face (total facial index of 83.9, or euryprosopic), a nose of medium proportions (nasal index of 49.5), and a medium amount of prognathism; while the latter were round-headed (cranial index of 84.2), with a broad forehead, broad cheek bones but long face (total facial index of 91.2), a nose of medium proportions (nasal index of 48.4), and a medium amount of prognathism.

KINGSTON (ILLINOIS) FOCUS OF THE MISSISSIPPI CULTURE

BY

ANSON SIMPSON

Peoria, Illinois

The Kingston Indian Village Site is located on a terrace-like rise of ground bordering the north shore of the lake and covers an area of ten acres. The terrace is a black loam from one foot to three feet in depth over a lense-like body of clay from zero to three feet deep. On this body of clay rested the village floor, from which the Indian artifacts were collected.

The many determinants taken from this site point strongly to the Monk's Mound aspect of the Middle Mississippi cultural phase.

Perforated *shell hoes* were very numerous, more than 140 were collected. *Deer jaw hoes* were common and showed much wear at point of hafting and also at point of use. Many *potsherd hoes* were also collected.

Stone implements consisted of pitted stone, whet stone or sharpener, anchors, sinkers, sandstone mortars or paint stones, and many small celts.

The *projectiles* were the thin triangular edged type of stone. A few were made from deer horn. *Knives* were the thin flaked edged type. *Scrapers* of the bunt variety were numerous. Bone and horn *awls* were very common, over 100 were collected.

Other determinants were beamers, game bones, wooden ear-spools (copper jacketed), skull trophies, discoidals, large effigy pipe (of stone), tempered pottery paste (not fired), wedge tools of horn and bone, bone plaques, pottery tools of the mushroom type, fragments of many bone ornaments, woven fabric of several weaves, carbonized corn and cobs, pecans, walnuts, and hickory nuts, also thin flakes of copper. Copper beads and over 690 shell beads came from one cache.

Pottery of the globular type, smooth and cord-imprinted shell-tempered, decorated and plain were found at all campfire sites and in storage pits. The outstanding characteristic of the sherds procured is the great variety of pots they represent, viz, ollas, plates, shallow bowls, bottle tops, and beakers which vary as to shape of rim, lip, shoulder, decoration, and handles.

Ollas, the globular shaped vessels, have their outer surface textile imprinted or smooth. A few show finger imprints on inner and outer wall. The rims also have a wide range of style, viz: flaring, verticle, rolled and flat. The decorations are mostly of incised geometrical designs on the shoulder of the vessel. Some of the small ollas have effigy forms on rims and handles.

The *plates* are shallow and of various sizes; black and red in color, and have decorated rims. A few are scalloped.

The *shallow bowls* are of various sizes with a maximum diameter of nineteen inches. They have rimless thick walls ending in a flat lip, and are without decoration. A few show fabric marking on the base.

The *bottle tops* are globular, like the ollas, but have contracted necks and narrow rims and are without decoration.

The *beakers* are the most unique of all the types. The walls are thin, verticle or slightly flared, the base flat, and the pots small compared with the other types. Red and black colors predominate. The decoration consists of scroll work and incised lines and the design covers the outer wall of the vessel. Many have effigy-like forms for handles. The effigy forms of others extend from the vessel lip. The colors are red to black and polished.

Several more traits of these people have been found at the Kingston Site, which point, no doubt, to the Middle Mississippi classification.

PREHISTORIC TIMETABLES

BY

JOHN VOSS

Peoria, Illinois

ABSTRACT

A method now used by the botanist for the determination of the age, changes in forest constitution and climatic conditions during interglacial periods is pollen analysis. In the British Isles (1, 2) the same method has also aided the anthropologist in estimating the age of the artifacts which sometimes occur buried in peat deposits. If careful stratigraphical studies were made of American peat deposits located near former campsites, data could probably be obtained which would be of value in dating the artifacts of the prehistoric American cultures.

1. MOIR, J. R., New evidences of ancient man. Scientific American April 1928.
2. WOODHEAD, T. W., History of the vegetation of the southern Penninines. Jour Ecology 17:1-34. 1929.

PAPERS IN BOTANY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

All of the seven papers on the Botany program were presented before the members and guests of the section and all but one are here represented. Dr. A. G. Vestal's article, entitled, "Rock ledge vegetation in southern Illinois," was not handed in for publication.

Attendance at the section meeting averaged fifty.

Dr. W. N. Bailey, Southern Illinois State Normal University, Carbondale, Illinois, was elected chairman of the section for 1934-35.

(Signed) E. L. STOVER, *Chairman*

BARBERRY ERADICATION IN ILLINOIS

BY

ROBERT W. BILLS

U. S. Department of Agriculture, Bureau of Plant Industry

ABSTRACT

The common barberry, originally from the Himalaya Mountains of Asia, was carried into eastern Europe and from there to America by early colonists. The fight against the rust-spreading plant was begun locally in grain producing regions in France about 1660. The program was soon taken up in Germany and England and in the American colonies as early as 1726. A nation wide campaign was carried on in Denmark in 1903 after a law was passed against this bush. In 1918, the United States Department of Agriculture cooperating with state agencies, started a campaign to eradicate common barberry from thirteen north central grain producing states.

The ability of this plant to multiply and be distributed and to adapt itself to growing under various conditions of soil and moisture has complicated the fight to exterminate it.

One barberry location was referred to near Southborough, Massachusetts, where a spread of rust was reported in 1795 by Timothy Dwight, President of Yale. One bush was accused of causing serious rust damage to a wheat field. Pictures were shown to illustrate how the barberry has multiplied until now there is a wilderness of barberries growing in some of the fields of that region. In this section the bush has become a pasture weed.

A location in Lake County, Illinois, was described as having spread from a planting in Gurnee. Woodlands, fence lines, and roadsides covering about 35 square miles have been infested by the progeny of that one planting. Bushes were most numerous on the H. C. Lake farm about one mile from the original planting. On that farm 48,425 bushes, many of them large, fruiting bushes, were killed from 1923 to 1925. A careful search of the farm netted 5,860 small to medium sized bushes in 1930, and an equally diligent search in 1933 resulted in the destruction of only 435 small bushes. Thus the barberry bushes are being brought under control.

A total of 2,669,411 common barberry bushes and seedlings has been found and destroyed in Illinois from 1918 to 1933. These plants, if they had been equally distributed, would have covered this State at the rate of one to each 13 acres. In the 13 States of the barberry eradication area, 19,107,232 barberry plants have been destroyed. Definite reduction of rust losses has followed the removal of these sources of infection.

The figures compiled by the Plant Disease Survey of the United States Department of Agriculture show that for the thirteen states of the Barberry Eradication area the average annual loss of wheat due to black stem rust during the six years 1916-1921 was 51,279,000 bushels; during the following six year period the average annual loss was reduced to 17,845,000 bushels; and during the last six year period 1928-1933 the average annual loss was brought down to only 3,471,000.

Barberries are known to be growing in many locations where the seeds have been scattered by birds and other agencies from old plantings. Practically all of the planted bushes have been destroyed. Records indicate the existence or probable presence of remaining bushes near locations where old bushes had grown. These records simplify the future search for bushes.

SOME BRYOPHYTES OF MACON COUNTY, ILLINOIS

BY

GLADYS CHARLOTTE GALLIGAR

University of Illinois, Urbana, Illinois

The following list of Bryophytes represents the species found in collections made in April and May of 1933 from woody ravines and banks of the Sangamon River and its tributaries and from roadsides and pastures in Macon County, Illinois. The names used are those found in "Mosses With a Hand Lens and Microscope" and "Mosses With a Hand Lens" by A. J. Grout. The work was done under the direction of Dr. Stella M. Hague of the Department of Botany, University of Illinois.

I. HEPATICAE:

JUNGERMANNIACEAE

Frullania eboracensis Gottsche. Tree.
Lejeuna cavifolia (Ehrh.) Lindb. Tree.
Lophocolea heterophylla (Schrad.) Dum. Stump.
Cephalozia bicuspidata Stump.
Jungermannia lanceolata L. (Liochlaena lanceolata). Stump.

II. MUSCI:

POLYTRICHACEAE

Catharinea undulata (L.) W. and M. River bank.
Catharinea angustata Brid. River bank.

FISSIDENTACEAE

Fissidens osmundoides (Swtz.) Hedw. Ravine.

DICRANACEAE

Ditrichum tortile (Schrad.) Hampe. Ravine.
pallidum (Schreb.) Hampe. Ravine.
Ceratodon purpurens (L.) Brid. Pasture.
Leucobryum glaucum (L.) Schimp. Woods soil.

TORTULACEAE

Weisia viridula (L.) Hedw. Pasture.
Pottia truncatula (L.) Lindb. Pasture.

FUMARIACEAE

Physcomitrium turbinatum (Mx.) Brid. Roadside.

BRYACEAE

Bryum caespiticium L. River bank.
Bryum argenteum L. Stone.
Rhodobryum roseum (Weis.) Limpr. Log.
Mnium cuspidatum (L.) Leyss (Mnium sylvaticum). Log.
Mnium affine ciliare (Grev.) C. M. Log.

LESKEACEAE

Thuidium delicatulum (L.) Mitt. Woods soil.
Thuidium pygmium Br. and Sch. Log.
Thuidium microphyllum (Sw.) Best. Log.
Leskea polycarpa (Ehrh.) Tree.
Leskea nervosa (Schwaegr.) Myrin. Tree.
Anomodon rostratus (Hedw.) Schimp. Tree.

HYPNACEAE

Brachythecium salebrosum (Hoffm.) Br. and Sch. Woods soil.
Brachythecium oxycladon (Brid.) J. and S. (B. Laetum B. and S.). Log.
Brachythecium cyrtophyllum Kindb. Log.
Eurynchium hians (Hedw.) J. and S. Woods soil.
Eurynchium strigosum (Hoffm.) B. and S. Woods soil.
Eurynchium serrulatum (Hedw.) Kindb. Woods soil.
Campylium chrysophyllum (Brid.) Bryhn. Stone.
Amblystegium serpens (L.) B. and S. Stone.
Amblystegium varium (Hedw.) Lindb. Woods soil.
Amblystegium riparium B. and S. Woods soil.
Plagiothecium micans (Sw.) Paris. Base of tree.
Entodon compressus (Hedw.) C. M. Tree.
Entodon cladorrhizans (Hedw.) C. M. Log.
Entodon seductrix (Hedw.) C. M. Tree.
Platygyrium repens (Brid.) B. and S. Tree.

MOSSES FROM THE ILLINOIS OZARKS

BY

STELLA MARY HAGUE

University of Illinois, Urbana, Illinois

The mosses listed in this paper were collected, with a few exceptions, during two visits to southern Illinois, July 17 to 22, 1931, and July 6 to 14, 1932.

The names and arrangement follow that given by Dr. A. J. Grout in Mosses with a Handlens and Microscope and Moss Flora of North America, Vol. III, parts 1, 2, 3 and Vol. II, part 1.

Abbreviations of the counties in which the mosses were collected: S—Saline; P—Pope; J—Johnson; U—Union; W—Williamson; H—Hardin.

SPHAGNACEAE

Sphagnum sp. ..... J.

POLYTRICACEAE

Catharinea undulata (L.) W. & M. ..... P.J.
Catharinea angustata Brid. ..... P.J.
Polytrichum commune L. ..... P.J.
Polytrichum ohioense R. & C. ..... J.

FISSIDENTACEAE

Fissidens adiantoides (L.) Hedw. ..... J.
Fissidens osmundoides (Swtz.) Hedw. ..... J.

DICRANACEAE

Ditrichum pallidum (Schreb.) Hampe. ..... S.J.P.
Dicranum heteromalla var. orthocarpa (Hedw.) ..... P.
Dicranum scoparium (L.) Hedw. ..... J.P.
Dicranum sp. ..... P.
Leucobryum glaucum (L.) Schimp. ..... J.P.

GRIMMIACEAE

Hedwigia albicans (Wel.) Lindl. ..... S.P.J.
(Hedwigia ciliata (Ehrh.) Hedw.)
Ptychomitrium incurvurm (Muhl.) ..... J.
Grimmia apocarpa (L.) Hedw. ..... J.P.H.U.
Grimmia ovata W. & M. ..... S.
(Grimmia commutata Hueben.)
Rhacomitrium sudeticum (Funk) B. & S. ..... S.J.
(Rhacomitrium heterosticum var. sudeticum (Finch) n.e.)

TORTULACEAE

Weisia viridula (L.) Hedw. ..... S.J.U.
Didymodon rubellus (Hoffm.) B. & S. ..... H.
Tortella caespitosa (Schwaegr.) Limp. ..... S.
Desmatodon plinthobus Sulli. & Lesq. ..... H.

ORTHOTRICHACEAE

Drummondia clavellata Hook. ..... J.

FUNARIACEAE

Physcomitrium turbinatum (Mx.) Brid. ..... W.
Funaria hygrometrica (L.) Sibth. ..... S.J.

AULACOMNIACEAE

Aulacomnium heterostichum (Hedw.) B. & S. ..... S.J.
Aulacomnium palustre Schwaegr. ..... J.U.

BARTRAMIACEAE

Philonotis fontana (L.) Brid. ..... J.
Bartramia pomiformis (L.) Hedw. ..... S.J.P.

BRYACEAE

Pohlia nutans (Schreb.) Lindb. ..... S.P.J.
Mnium cuspidatum (L.) Leyss. ..... S.J.
Mnium affine var. ciliare (Grev.) C.M. ..... J.
Mnium rostratum Schrad ..... S.J.
Mnium punctatum elatum Schimp. ..... J.

LESKEACEAE

Thuidium delicatulum (L.) Mitt. ..... S.P.
Thuidium recongnitum (Hedw.) Lindl. ..... J.U.
Thuidium pygmaeum B. & S. ..... S.
Thuidium minutulum (Hedw.) B. & S. ..... U.
Leskea polycarpa Ehrh. ..... S.J.P.U.
Leskea gracilescens Hedw. ..... S.
Leskea obscura Hedw. ..... S.J.
Anomodon minor (P. Beauv.) Fuern. ..... J.
Anomodon apiculatus B. & S. ..... S.J.P.
Anomodon viticulosus (L.) Hook & Taylor ..... J.
Anomodon attenuatus (Schreb.) Hueben. ..... S.P.
Anomodon rostratus (Hedw.) Schimp. ..... J.U.

HYPNACEAE

Thelia hirtella (Hedw.) Sull. ..... J.
Brachythecium salebrosum (Hoffm.) B. & S. ..... S.U.
Brachythecium oxycladon (Brid.) J. & S. ..... J.
Brachythecium acutum (Mitt.) Sull. ..... U.
Ciriphyllum Boscii (Schwaegr.) Grout ..... P.J.
Climatium Americanum Brid. ..... P.J.
Climatium Kindbergii (R. & C.) Grout ..... S.J.
Porotrichum Alleghaniense (C.M.) Grout ..... J.S.
Drepanocladus exannulatus (Guemb.) Warnst. ..... J.
Amblystegium serpens (L.) B. & S. ..... P.J.U.
Amblystegium Juratzkanum Schimp. ..... P.
Amblystegium compactum (C. Muell.) Aust. ..... P.
Amblystegium varium (Hedw.) Lindb. ..... U.
Amblystegium irriguum (Wils) B. & S. ..... J.
(Hygroamblystegium irriguum)
Amblystegium riparium var. trichopodium B. & S. ..... S.
(Leptodictyum trichopodium (Schultz) Laubm.)
Hygrohypnum ochraceum (Turn.) Loeske ..... P.
Hypnum curvifolium Hedw. ..... J.P.
Plagiothecium elegans (Hook) Sull. ..... U.
Plagiothecium micans (Sw.) Paris ..... P.U.
Amblystegiella confervoides (Brid.) Loeske ..... S.
Entodon cladorrhizans (Hedw.) C.M. ..... P.J.U.

LEUCODONTACEAE

Platygyrium repens (Brid.) B. & S. ..... S.J.P.
Leucodon julareus (Hedw.) Sull. ..... J.
Leucodon sciuroides (L.) Schwaegr. ..... S.

FONTINALACEAE

Fontinalis Lescurii Sull. ..... S.

NEW METHODS IN PALEOBOTANICAL MICRO-TECHNIQUE

BY

A. C. NOÉ

University of Chicago and Illinois State Geological Survey

The old method of examining a coal ball for interesting plant material which it might contain was to quarter it with a rotary diamond saw and then to prepare thin sections along the horizontal and vertical cuts. These thin sections had to be sliced off with the diamond saw and ground with at least three different grades of carborundum powder until microscopic thinness was obtained. The grinding was done either on glass plates or on rotating laps driven by motor power. To produce a good thin section mounted on a glass plate with Canada balsam took approximately one and a half to two hours; it took about one day to prepare a single coal ball for the preliminary tests.

Since 1928 when Walton and Koopmans published their cellulose peel method great progress has been made in the testing of coal balls in my laboratory. If the coal ball is sufficiently hard and not too porous all adherent coal and other mineral matter is removed with a hammer and the coal ball is dipped into a 10 per cent solution of hydrochloric acid. The latter is allowed to remove the surface of the uncut coal ball until any enclosed plant material becomes visible. Usually stem or root pieces, possibly also seeds which touch the surface can be seen and the orientation of the cuts can be planned. In accordance with the surface indications, the coal ball is now cut with the diamond saw into two, four or more blocks. The next step is to smooth the cut surfaces with carborundum powders in the successive grades of 120, 220, and 600, treating with a 10 per cent solution of hydrochloric acid until the plant organs are clearly visible. The cuts are carefully washed with water and dried. Their surfaces now present a very fine velvet of carbonized plant tissues from which, to a depth of perhaps 50 to 100 micra the matrix of calcium carbonate has been removed. This velvet is now soaked in butyl acetate and a 10 per cent solution of nitrocellulose in butyl acetate is poured over the moist surface. The use of nitrocellulose dissolved in butyl acetate has been worked out by one of my students, Roy Graham, who published his method in Stain Technology, April, 1933, pp. 65-68. The nitrocellulose solution is most satisfactory. We have tried solutions of parlodion or of pyroxilin in ether and alcohol, or of cellulose acetate in acetone, or of purified collodion. The nitrocellulose solution produces a satisfactory film which does not curl but sticks closely to the surface of the coal ball until removed with a safety razor blade. It also gives a very transparent film which does not need to be cleared with xylol or with Eycleshymer's clearing fluid. It is usually necessary to apply several coats of nitrocellulose. The successive coats can be applied as soon as the previous coat begins to harden. I found that three coats are usually necessary to produce a very coherent film. The films can be filed in paper envelopes to be examined at any convenient time. For the examination I use a binocular microscope with a magnification of about 25 or 50. If the film discloses interesting details, squares are cut out of it with a safety razor blade and mounted on glass slides in Canada balsam. The drying of a film takes 6 to 8 hours but it is easy to prepare a dozen coal balls in a day and have the films dry during the night. Nitrocellulose solutions in butyl acetate are not very sensitive to moisture and sufficient drying of etched coal balls can be accomplished in an electric oven in a few minutes. The new method is at least ten times faster than the old one. The same advantages prevail when it comes to the minute study of selected material for research purposes.

THE EFFECT OF ULTRA-VIOLET LIGHT ON THE FERMENTING ABILITY OF YEASTS

BY

FRED W. TANNER AND J. ROY BYERLY

Department of Bacteriology, University of Illinois, Urbana, Illinois

Problem: This problem was suggested by the discordant reports in the literature concerning the effect of ultra-violet on the fermenting ability of yeasts. Some workers report that ultra-violet light accelerates the fermenting ability of yeasts, while others report that ultra-violet light greatly inhibits their fermenting ability.

Method: In view of the differences of opinion on this question, it was decided to repeat and extend some of the experiments. More refined methods have been developed which allow more reliable results. Four different modifications of technique were used as follows: (1) irradiation of dextrose-broth cultures, (2) irradiation of aqueous suspensions of yeast before inoculation, (3) irradiation of fermenting cultures, (4) irradiation of dextrose broth before inoculation. Each experiment was carried out in duplicate and in some cases many times.

The source of ultra-violet light in this experiment was a Cooper-Hewitt lamp operated at 110 volts and 5 amperes (D. C.) at a distance of 25 cm. A fairly constant temperature was maintained during irradiation by means of an electric fan directed toward the light. A fermentometer described by Rahn (1929) was used to determine the rate of fermentation. This method of measuring fermentation has the advantage of determining the rate for very short intervals of time immediately after exposure, thereby eliminating the possibility of fermentation by cells which were never exposed to the light. The gas pressure in the fermentometer was produced against mercury in the open arm. The record of the pressure was kept in millimeters of mercury. All irradiation was carried out in quartz flasks.

Saccharomyces cerevisiae and Fleischmann's commercial pressed yeast were the principal yeasts used in this experiment.

Conclusions

(1) Yeasts are destroyed when exposed directly to the effects of ultra-violet light.

(2) Irradiation of dextrose-broth cultures of fermenting yeasts in quartz apparatus for periods of time totaling 1 hour and 20 minutes seriously inhibited their fermenting ability.

(3) Exposure of yeasts in aqueous suspension to ultra-violet light destroyed so many cells that no gas was formed in 24 hours; very small amounts were formed in 31 hours. The non-irradiated controls showed regular active gas formation.

(4) Exposure of dextrose-broth cultures to ultra-violet light after fermentation had begun, greatly inhibited gas formation.

(5) Dextrose broth irradiated for a long time before inoculation tended to ferment more slowly than the non-irradiated control media.

(6) No observations were made to indicate that exposure of yeasts or media to ultra-violet before inoculation increased the amount of gas formed.

A STRATIGRAPHICAL STUDY OF THE MANITO SWAMP

BY

JOHN VOSS

Manual Training High School, Peoria, Illinois

East of the city of Manito, Mason County, Illinois, may be found a portion of an abandoned channel which during Late Wisconsin times was probably occupied by the Illinois and Mackinaw rivers. The channel is filled with peat averaging 6 feet in depth and contains important records of value in the reconstruction of the postglacial history of the Illinois valley. Unfortunately much of that record has already been destroyed through drainage and by the removal of some of the peat for commercial purposes. Although the removal of the peat has destroyed some of the buried records, it has, nevertheless, made it possible to collect macroscopic material which otherwise could not have been obtained by the common method of drilling.

The origin of the sand upon which the peat rests is attributed to the period when the Kankakee Torrent was at its height. The water originated from the exceedingly rapid melting of the ice of the Michigan, Saginaw, and Erie glacial lobes and entered Illinois River via the Kankakee. So rapid was the melting that, according to Ekblaw and Athy (2), the glacial river in northeastern Illinois varied in width from 5 to more than 12 miles. A wide channel also occurred south of the city of Pekin and extended south to Meredosia, Morgan County. In that channel the raging flood waters at first deposited coarse material, and later, as the water subsided, deposited sand. Subsequent to the decline in water level, peat accumulated in the undrained portion of the former channel.

The peat collected for laboratory study was obtained from the eastern margin of Section 26. At that point the Manito Chemical Company had removed all the organic soil to within a foot of the sandy bottom and thereby exposed excellent profiles of the peat beds. The material was black throughout, varied considerably in texture, and the top soil was loose and granular owing to drainage and subsequent aeration. The profiles showed the peat to be typical of that generally found in shallow undrained depressions. Such peat accumulates very slowly and for that reason samples were taken every inch from the bottom to top. Although pollen grains were found in most strata, their sparsity, due to the nature of the peat and the resultant effect of drainage, would not give a true picture of the vegetation succession.

The height of the water table is, according to Dachnowski (*1*), the principal factor governing the type of plants to be found on bogs. Laboratory studies revealed that at the outset, the water in the section of the swamp from which the samples were taken, was shallow. This was indicated by the occurrence of many seeds of *Menyanthes trifoliata* and sedge remains in the first four inches of the bottom peat. This stratum was also characterized by the abundance of leaves, lateral spurs, and cones of *Larix*.

Five inches above the bottom there occured a thin band of inorganic soil consisting of a mixture of sand and clay. This may have been deposited either by wind or water. Upon this layer and associated with *Larix* leaves were many specimens of the mosses *Drepanocladus revolvens intermedius* and *Campylum stellatum*.

Immediately above the mineral soil the water doubtless was shallow as indicated by the occurrence of *Menyanthes* seeds. Four inches above the silty layer *Sphagnum* occurred. Its presence together with the appearance of much *Picea* and *Larix* wood signified that the surface of the bog was built

up above ground water level. *Picea* and *Pinus* pollen were also abundant in the *Sphagnum* stratum.

Above the Sphagnum layer the macroscopic material indicated a change in water level which brought about the destruction of Sphagnum by submergence. From the 9-inch level to the 18, the material consisted chiefly of sedge remains and the leaves of *Larix*, the latter probably having grown on the more elevated portions of the bog. *Salix* pollen occurred at the 10-inch level; *Picea*, *Quercus*, and many *Pinus* pollen at the 11-inch level. *Pinus* pollen was also common in the upper part of the layer and at the 17-inch level *Quercus* pollen was the most abundant.

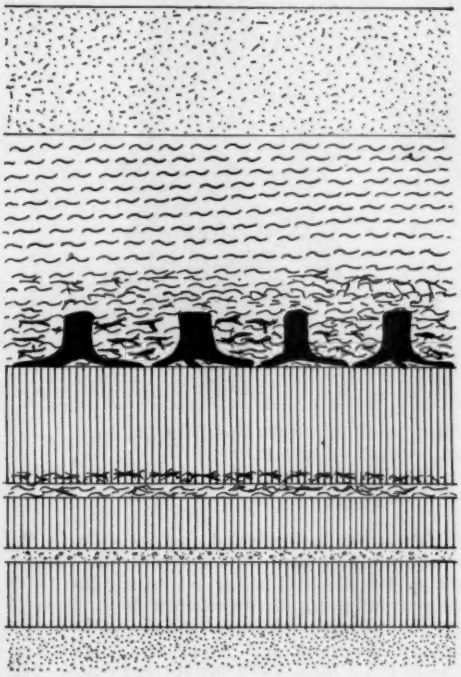


FIG. 1. Diagram showing structure of peat bed. *(Cut supplied by author.)*

As the surface of the depression gradually became higher owing to the deposition of peat, the water table at the 18-inch level became low enough to permit the growth of Sphagnum. Sphagnum persisted from the 18 to the 36-inch level as one of the important peat forming agents. At the 20-inch level *Menyanthes* seeds were common, and 21 inches above the bottom numerous well preserved roots and stumps of *Larix* and *Picea* were present indicating again that the surface of the bog was above ground water level. Woody peat accumulates very slowly and its thickness indicated that the swamp forest of spruce and tamarack remained for a long period. The presence of *Betula* pollen, leaves of *Betula pumila*, and annuli of *Polypodiaceae* in the upper portion also suggested maturity. Pine pollen was found throughout indicating that the tree probably grew either on the bog

or on the surrounding sandy soil. Conditions with reference to the surrounding sand cover may have been similar to those of northeastern Illinois (*3*) where the oak is gradually superseding the pioneer pine.

From the 36-inch level to the top, the soil, owing to drainage, was black, well decomposed and contained practically no material of value in the reconstruction of vegetational history.

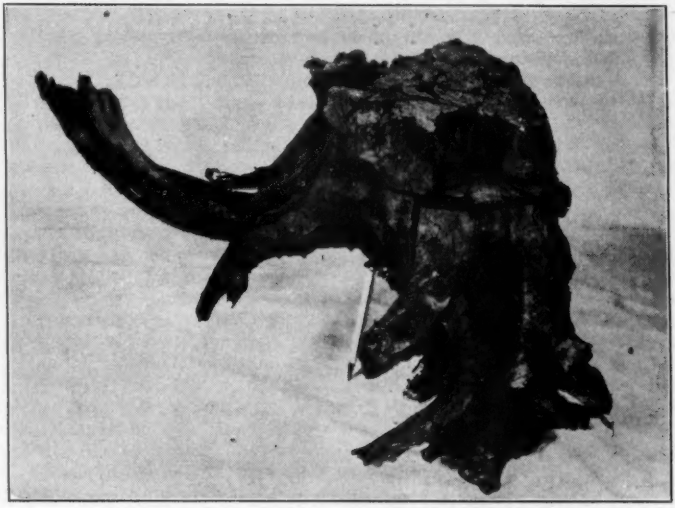


FIG. 2.—Tamarack stump found 21 inches above the bottom.
(Cut supplied by author.)

SUMMARY

The stratigraphy of the Manito swamp indicated that as soon as the channel was abandoned by the Mackinaw and Illinois rivers, the edaphic conditions favored the growth of boreal shoal water plants together with *Picea* and *Larix* on the more elevated parts of the channel floor. Several fluctuations of water level occurred during the history of the swamp as shown by the alternating layers of sedge, sphagnum, and woody peat. During at least two distinct periods of the swamp's history the surface was dry enough to support the growth of *Larix* and *Picea*. The last swamp forest persisted for a long time and doubtless passed through the same successional stages as found on some of the mature bogs in northeastern Illinois. What the final stages were is difficult to say owing to the destruction of the plant remains by drainage and subsequent aeration. All evidence thus indicated that the abandoned channel served as one of the pathways for the northward movement of plants which had previously been forced in the opposite direction by the advancing ice.

1. DACHNOWSKI, A. P., Factors and problems in the selection of peat lands for different uses. U. S. Dept. Ag. Bull. 1419, 1926.
2. EKBLAW, G. E., and ATHY, L. F., Glacial Kankakee Torrent in northeastern Illinois. Bull. Geol. Soc. America, 36:417-428, 1925.
3. GATES, F. C., The vegetation of the beach area in northeastern Illinois and southeastern Wisconsin. Bull. Ill. Nat. History Survey, 9:255-372, 1912.

PAPERS IN CHEMISTRY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Of the ten papers on the Chemistry program, only eight are here represented. One was not given, two were read by title, and the following, although given at the meeting, was not presented for publication:

"Some metathetic reactions of iodine mono-chloride," by H. W. Horrabin, Western Illinois State Teachers College, Macomb, Illinois.

Average attendance at the meeting was fifty-five, maximum was sixty-five.

The present chairman was re-elected to serve for 1934-35.

(Signed) FRED A. DYKINS, *Chairman*

A NEW AERATION PROCESS FOR THE PREPARATION OF WHIPPED CREAM

BY

C. A. GETZ WITH G. F. SMITH

University of Illinois, Urbana, Illinois.

The preparation of whipped cream by the process of mechanical whipping has a number of disadvantages. Cream of relatively high butter fat content, preferably 32 per cent, is required. The cream should have been separated from the milk for approximately 24 hours and should be whipped cold. By this process the volume of whipped cream produced is twice the volume of cream used. This is known as a 100 per cent overrun.

The whipping of cream involves a reversible reaction of aeration. During the first part of the whipping air is introduced in the form of minute bubbles which accounts for the expansion of the cream volume during whipping. Continued beating of the cream then tends to decrease the expansion due to the incorporation of air to such an extent that an equilibrium is attained. Beyond the equilibrium point as much air is beaten out of the cream as is incorporated into the cream by the beating process. Oftentimes this equilibrium point is not attained without the formation of butter globules and if the process is continued much beyond the equilibrium stage butter is the inevitable result.

Mechanical devices have been manufactured and distributed to produce a higher overrun in the mechanical whipping of cream than is ordinarily the case. The ordinary whipping process is supplemented by the introduction of a stream of air under presure through the body of the cream during the whipping operation. Essentially the same requirements for the compressed air process must be fulfilled as for the ordinary whipping method and the results obtained are noteworthy in that as much as a 200 per cent overrun can be obtained. In other words, the ordinary whipping operation is made more efficient in attaining a larger volume for the final product by shifting the previously described equilibrium in the direction of greater absorption of air throughout the body of the cream.

The process described in connection with this outline represents an entirely new principle of aeration. Cream of any age and varying in butter-fat composition between 22 and 36 per cent is treated under pressure with one of a possible series of soluble gases in a special container. The whipped cream can be delivered in large or small quantities under the gas pressure employed in charging the cream and all the advantages previously described for the improved aeration by the air pressure method are greatly augmented. Higher overruns are obtained; any portion of the cream treated can be delivered at a given time; and the butter-fat content of the cream treated can be varied over a much wider range.

Gases suited to the newly described aeration process should have the following characteristics:

1. Their solubility in water should equal that of one volume of gas per unit volume of water at ordinary temperatures.
2. The gas should be colorless, odorless, and tasteless.
3. The gas should be obtainable in a high state of purity in storage cylinders, the internal pressure of which is in excess of that required for the charging of the gas into the cream at the desired pressure.

The gases which satisfy these characteristics are four in number, namely: carbon dioxide, nitrous oxide, dimethyl ether, and dichlor-difluor-methane.

Of these, carbon dioxide leaves the whipped cream with a carbonated beverage taste. For some uses this quality is not objectionable, but for others this is not satisfactory. Nitrous oxide is the practical equivalent of carbon dioxide and has none of its objections. It is obtainable in large quantities in steel cylinders under 800 lbs./sq.in. pressure. The purity of the gas is beyond question and its physical characteristics are perfectly adapted to the process involved.

The specific operation of the process using 26 per cent cream is as follows. A half-pint of cream is placed in the pressure bottle which is provided with a siphon tube, a pressure valve of the Schrader type and a delivery nozzle. Nitrous oxide is charged into the cream with gentle shaking until the pressure has reached 80 lbs./sq.in. The pressure is then automatically cut off by the Schrader valve and the delivery nozzle is inserted on the bottle. The cream may then be delivered, intermittently or continuously, by operation of the valve until the contents are used. It is found that the overrun thus obtained is approximately 260 per cent. The drainage from this cream is no greater than that obtained from the same volume of cream whipped by the old method. If desired, the cream may be sweetened and flavored before charging with gas in the bottle. By this process almost a quart of whipped cream is obtained from one-half pint of 26 per cent cream.

It is proposed to market this cream in pressure bottles. The cream will be sweetened and flavored and charged with the necessary quantity of gas and will be distributed to the consumer by much the same process as the consumer now receives the daily supply of milk and cream. After the contents have been used, the bottle with the delivery nozzle detached is returned to the milk distributor and replaced by a full bottle. In case all the contents are not used at one time, the delivery nozzle may be removed from the bottle and the remaining contents stored in the ice box under ordinary conditions until required for further use. The delivery nozzle can be washed by the housewife in the usual fashion but the empty container is washed and sterilized by the dairy manufacturer engaged in this distribution. Cream thus charged has been kept in a refrigerator for one week without deterioration. After this time, the cream delivered has been as satisfactory as that obtained on immediate use. This process has been protected by patent application and sufficient illustrations of the principles involved have been provided to constitute general protection from infringement by imitators.

THE OCCURRENCE OF A PECTIN MATERIAL IN ARTICHOKE SIRUP

BY

H. E. HARRISON WITH D. T. ENGLIS

University of Illinois, Urbana, Illinois

The preparation of a palatable sirup from Jerusalem artichokes has been previously described (*1*). In this connection it was pointed out that the manufacture of the sirup was in a sense a preliminary step in an attempt to produce pure levulose by a direct crystallization from the raw sirup. Further work toward the major objective has been concerned with the constituents of the extract which might cause inhibition of crystallization.

Since levulose is extremely soluble, a very high concentration is necessary to reach a saturation value. Nevertheless, the crystallization of the sugar from an aqueous solution of the pure compound can be accomplished with a fair degree of ease. The difficulties encountered with the raw sirup emphasize the great significance of the impurities.

It was believed that one of the factors contributing to inhibition of crystallization was the high viscosity of the sirup at the necessary percentage of solids. It appeared reasonable that pectic substances might be present and responsible for this condition. These substances are found widely distributed in plants. The deposit of jelly-like masses in cans of the artichoke sirup which had been allowed to stand for some time pointed to the existence of some material of pectic nature.

For the isolation of the material samples of sirup were diluted to a sirup of about 50 per cent solids and 95 per cent alcohol added until the concentration of alcohol in the mixture was about 70 per cent. The jelly-like precipitate was removed, redissolved in water and reprecipitated several times.

The purified material had a specific rotation of 105, which is in the lower range of values reported for pectic materials. A portion of the sample was hydrolyzed (*3*) and finally tested for galacturonic acid. The crystalline character of the compound, temperature at which it discolored, and melting point confirmed its presence.

The quantity of apparent uronic acid in the pectic substance was determined by measurement of CO_2 evolved under regulated conditions (*4*). Values obtained were of the same order as those obtained with a pure citrus pectin under identical circumstances.

Enzymes of the pectin system were prepared from *Rhizopus nigricans* and the artichoke material was subjected to their action. Reduction in amount of available pectic acid, as determined by the method of Carre and Haynes (*2*), was indicated. The rate of saccharification of the sample by the pectic enzymes was similar to that obtained with citrus pectin.

Through the kindness of Mr. R. R. Sterrett and Mr. R. A. Stegeman, X-ray diffraction photographs were made of the artichoke material and citrus pectin. These photographs showed some relationship between the artichoke material, citrus pectin and polygalacturonic acids, but the work has not yet progressed to the stage at which definite conclusions can be drawn.

Further work is in progress to furnish additional information concerning this interesting constituent of the artichoke sirup.

1. DYKINS and ENGLIS—Trans. Ill. Acad. Sci. (1933).
2. HAYNES and CARRE—Biochem. J. 16, 60 (1922).
3. LINK and DICKSON—J. Biol. Chem. 86, 491 (1930).
4. NANJI, PATON and LING—J. Soc. Chem. Ind. 44, 253 T (1925).

THE EFFECT OF POTASSIUM CYANIDE UPON AMYLASE ACTIVITY

BY

J. O. PAGE WITH D. T. ENGLIS

University of Illinois, Urbana, Illinois

Many interesting studies (*2*) have been reported concerning the effect of cyanides upon various enzymes. Hanes and Barker (*3*) mention that under suitable conditions they increase the activity of malt amylase. Prompted by certain phenomena occurring as a result of chemical treatment of dormant potatoes, Denney (*1*) investigated the influence of KCN upon potato amylase. Small amounts of the reagent did markedly increase the activity of the undialyzed juice but after dialysis little or no effect was noted. Denney also observed that the increase due to cyanide decreased as the pH of the medium increased.

These experiments were of particular interest in connection with some work in progress in this laboratory upon barley amylase. This enzyme shows its optimum activity at a much lower pH than potato amylase and it seemed desirable to establish the effect of KCN under varying conditions upon the former. Both ungerminated barley and barley malt were used as sources of the enzyme. The materials were finely ground and sieved. Portions were then allowed to soak in distilled water over night and the clear liquid introduced into the substrate material. The substrate was prepared from soluble starch according to the general procedure of Sherman and Thomas (*5*). The control and treated solutions were prepared separately. In the case of the treated samples the appropriate amount of KCN solution, previously adjusted to the desired pH, was introduced into the substrate before making up to volume.

In selecting conditions for experimentation a pH of 4.56 was selected as being near the optimum for barley amylase and pH of 7 as one less favorable to the action of the enzyme. The solutions were buffered to maintain the desired pH. The substrate was first brought to a temperature of 40° C. and the amylase introduced and the mixture held at 40° C. during the progress of the reaction. At regular intervals portions of the mixture were withdrawn and the rate of saccharification determined by the method of Lane and Eynon (*4*). With undialyzed enzyme preparations containing 10 mg. of KCN per 100 cc. of substrate in the treated sample very little difference in rate of reaction was noted between treated and control when the pH was maintained at 4.56. When the pH was increased to 7 the rate of saccharification was much greater for the KCN treated samples. However, the rate for the latter was practically identical with that observed for a pH of 4.56. This seems to indicate that the cyanide tends to make the enzyme less subject to change in activity due to change in pH. Reduction in normal activity by increase in pH from 4.56 to 7 seems to be prevented by addition of the KCN.

LITERATURE CITED

1. DENNEY, F. E—Contributions from Boyce Thompson Institute 3, 297 (1931).
2. HALDANE, J. B. S.—Enzymes—Longmans, Green and Company, London (1930).
3. HANES, C. S. and BARKER, J.—Proc. Roy. Soc. 108 B 95 (1931).
4. LANE and EYNON—J. Soc. Chem. Ind. 42, 32 T (1923).
5. SHERMAN and THOMAS—J. American Chemical Society 37, 623 (1915).

THE USE OF CERIC SULFATE FOR THE DETERMINATION OF CUPROUS OXIDE OBTAINED BY THE ACTION OF REDUCING SUGARS ON FEHLING'S SOLUTION

BY

R. A. STEGEMAN WITH D. T. ENGLIS

University of Illinois, Urbana, Illinois

Existing methods for the volumetric determination of cuprous oxide, especially as applied to standard procedures for the estimation of reducing sugars, fall quite generally into two classes—iodometric and manganimetric. All fail to fulfill the essential requirements of convenience, accuracy, and low costs. Iodometric methods are based upon an equilibrium which, under correctly controlled conditions, can be made to proceed in either direction (*5*). While good results can be obtained, accuracy is usually sacrificed by modifications tending to lower the cost of the procedures. Manganimetric methods (*1, 2, 3*) have proved rather unsatisfactory, due to the high oxidation potential of permanganate which causes it to oxidize adsorbed organic material, as well as to the difficulty of detecting the permanganate end-point in a blue copper solution.

Ceric sulfate (*6*) offers advantages which adapt it to the determination of cuprous oxide. It is exceptionally stable, even in the presence of quite variable concentrations of sulfuric acid. It can be used in the presence of hydrochloric acid, which is often suggested to assist in the solution of cuprous oxide. The valence change is simple and there is no danger of the cerous sulfate formed being reoxidized by exposure to the air. Its oxidation potential is less than that of permanganate, which minimizes its effect upon the adsorbed organic matter. It can be obtained commercially or easily prepared at low cost. Its former disadvantage, the lack of a suitable indicator has now been overcome by the introduction of orthophenanthroline ferrous complex, a reversible indicator (*7*).

A stoichiometric relationship is found to exist between Ce^{++++} and Cu^{+}. This is made use of by separation of the cuprous oxide from the reducing solution, solution in a known amount of standard ceric sulfate solution, and titration of the excess ceric sulfate with ferrous sulfate, using orthophenanthroline ferrous complex as indicator. The color change at the end-point (orange-red to blue-green) is easily distinguished. The method can be applied to all reducing sugar determinations involving separation of the cuprous oxide from the reducing solution. Good results are obtained over a variety of conditions.

A comparison of the method with similar methods involving permanganate and dichromate was made, dichromate having been suggested and used by Jackson and Mathews (*4*), whose procedure, however, required an electrometric end-point. The permanganate method selected was that of Bertrand (*1*), modified by the application of orthophenanthroline ferrous complex as an aid in detecting the end-point. Dichromate was used in the same manner as ceric sulfate, using barium diphenylamine sulfonate as internal indicator. Ceric sulfate proved superior to both, permanganate giving consistently high results, in spite of the fact that the use of orthophenanthroline ferrous complex reduced the error, while dichromate, using indi-

cators now available, necessitates the application of an end-point correction which varies with the volume of solution used.

The procedure for the determination of cuprous oxide using ceric sulfate as outlined appears to offer advantages which should permit its wide application to reducing sugar determinations.

LITERATURE CITED

1. Bertrand, Bull. Soc. Chim., *35*, 1289-1299 (1906).
2. Bisson and Sewell, J. A. O. A. C., *10*, 120 (1927).
3. Caven and Hill, J. Soc. Chem. Ind., *16*, 981 (1897); *17*, 124 (1898).
4. Jackson and Mathews, Bur. Stds. J. Research, *8*, 424 (1932).
5. Shaffer and Hartman, J. Biol. Chem., *45*, 349-390 (1920).
6. Smith, G. F., "Ceric Sulfate," Columbus (Ohio), 1933.
7. Walden, Hammett and Chapman, J. Am. Chem. Soc., *53*, 3908 (1931).

A FEW SUGGESTIONS ON THE TEACHING OF FUELS IN ELEMENTARY CHEMISTRY

BY

G. T. FRANKLIN

Lane Technical High School, Chicago, Illinois

ABSTRACT

The usual study of the composition and source of ordinary fuels such as coal, coke, alcohols, gasoline, etc., is recommended. The study of heat values is practical chemistry applied to human needs and human progress. Emphasis is placed upon the teaching of quantitative relationships, although in doing so criticism may develop from the inability of the learner to include all factors in making conclusions. This may lead to partial and even misleading ideas. It is pointed out that the nature of the subject of chemistry is such that the use of pure mathematical methods has its limitations. The growth of ideas is necessarily slow. If, during the acquisition of fundamental concepts, wrong ideas for a time enter there should be no cause of worry. The growth of the individual in generalization is analagous to that of the race. With the limited knowledge of the race of fifty years ago it is perfectly natural that the learner should think as the learner of that time. The important thing is that the learner continue the ability to modify his general notions as he acquires new facts.

It is recommended that the pupil be led inductively through the development of such ideas that fuels with a large percentage of hydrogen by weight have high heat values. This may be developed by taking the heats of formation of carbon dioxide and water from standard publications and calculating in each case the calorific value per gram of these elements. The application of these facts to the estimation of heat values from percentage compositions is recommended. The effect of oxygen in fuels is easily taught.

Gaseous fuels are composed of a few simple units, by studying the heat values of which the learner is prepared to estimate the heat values of these fuels from their composition. An opportunity is offered in this study of reviewing such topics as the meaning of a formula, law of combining volumes, and the Avogadro principle. The idea that hydrocarbons are decomposed into elements, which burn as uncombined substances is noted. The law of heat summation is used as a matter of common sense without any attempt to formulate the law in terms of mathematical symbols.

The oxygen required for the combustion of fuels is studied in relationship to heat values. Equations are written showing that for the combustion of one atomic weight of carbon (twelve grams) one volume of oxygen is needed, while for the combustion of an equal weight of hydrogen three volumes of oxygen are needed. Numerous equations involving the combustion of various elementary units of which fuels are composed are recommended as project work. Attention is called to the oxygen needed for combustion and the luminosity of flames.

Attention is called to the need of teacher explanations that such studies are more or less idealistic to the extent that because a fuel has a high heat potential is no sure indication that it is being realized in practice. The efficiencies of heaters and calorimeters are compared. Calculation furnishes the goal to be attained in future methods of manufacture; it should encourage invention.

EXPLOSIVE REACTION OF PERCHLORIC ACID WITH METALLIC BISMUTH

BY

D. G. NICHOLSON AND J. H. REEDY

University of Illinois, Urbana, Illinois

In studying the use of perchloric acid as a solvent for alloys, violent explosions were met in the cases of alloys containing bismuth. Muir[1] has reported that bismuth is soluble in dilute perchloric acid forming the insoluble bismuthyl perchlorate. Fichter and Jenny[2] worked with concentrated perchloric acid and obtained soluble bismuth perchlorate. They state that the reaction is often accompanied by explosions due to chloric acid and chlorine dioxide formed by the reduction of the perchloric acid.

There is no apparent reaction of bismuth with 70 per cent perchloric acid at room temperature. Upon heating to 105-110° centigrade the metal becomes coated with a brown-to-black layer which explodes upon either continued heating or a sudden shock such as dropping, with terrific violence shattering the vessel and throwing the hot acid for surprising distances. After such a decomposition the metal again takes the bright appearance as before. The same procedure may be repeated indefinitely as long as the crystal of metal remains of suitable size. The fact that after explosions the metal is badly shattered, suggests that the acid had penetrated the cleavage planes of the crystal prior to the explosion.

The violence of the reaction is reduced by alloying the metal with other metals. High temperature or sudden shock favor the decomposition, while on the other hand the activated metal loses its dark color and activity if allowed to remain in air for some time. A convenient and less hazardous method of preparing the explosive metal is to dip a fragment in the acid by means of tongs, and carefully heat above a Bunsen flame.

The unstable nature of the material made a chemical analysis impossible. Analysis of the products formed by the decomposition showed them to consist largely of bismuthyl chloride. The ratio of chloride to bismuth ions present in this residue was approximately three to eight. This indicated that there was direct solution of the metal, in all probability to the normal perchlorate, as well as the formation of the metastable material. The presence of the bismuthyl chloride was verified by X-ray analysis.

Proof has been established to show that this unstable material is not an amphoteric form of bismuth, it is not due to impurities in the metal, and it is not due to formation of anhydrous bismuth perchlorate. Electrolysis of a solution of this perchloric acid using bismuth electrodes resulted in an explosion at the anode, while the cathode was coated with a fine very stable layer of bismuth. Thus it must be an oxidation product of bismuth in some metastable condition. One possibility would be pentavalent bismuth, although sodium bismuthate is stable when mixed with 70 per cent perchloric acid.

Plunging the darkened metal into water results in the solution of the dark colored material with no further reaction. Aqueous solutions of perchlorates are without reaction with the metal. Dilute perchloric acid likewise gives no explosive material. Plunging a blackened piece of the metal into potassium iodide solution liberated no free iodine.

The explosions are not due to reduction products of perchloric acid as tests for chloric acid with aniline sulfate were negative.

---

[1] Chem. News. *33*, 15 (1876).
[2] Hel. Chim. Act. *6*, 225 (1923).

THE TECHNIQUE OF MICROCHEMISTRY

BY

J. H. REEDY

University of Illinois, Urbana, Illinois

Micro methods in analytical chemistry were first developed as a separate art by Behrends in 1880 at the University of Delft, in Holland. Since then it has grown rapidly, and has been differentiated into specialized forms, as the micro methods of Emich, the spot tests of Feigl, the quantitative procedures of Pregl, and the microscopical procedures of Chamot.

Qualitative procedures may be roughly classified as (1) test tube methods, using approximately one cubic centimeter of solution, and (2) spot methods, using drops placed on slides, plates, or filter paper. Microanalysis requires special technique in such operations as heating, evaporation, precipitation, washing of precipitates, sublimation, and so forth.

The substitution of micro methods for the usual macro methods of qualitative analysis is not desirable in elementary classes, since the reactions employed are too largely organic. Furthermore, there would be a tendency to stress technique instead of the fundamental chemistry.

CHANGES IN THE HYDRATION OF THE SERUM COLLOIDS AS A GENERAL FEATURE OF DISEASE

BY

KAMIL SCHULHOF

Chicago, Illinois

The importance for individual therapy of the blood changes investigated by J. E. R. McDonagh made it desirable to obtain more objective measures of some of them, especially the hydration of the proteins. Since this association of the water (more correctly salt and sugar solution) with the proteins is apparently only of a physical nature, the obvious chemical methods fail. The equation:

$$\frac{(1 + \phi) \text{ log. nat. } \eta/\eta_o)}{\phi \ (1 + \text{log. nat. } \eta/\eta_o)} = K$$

(in which η is the relative viscosity of the system; η_o the relative viscosity of the dispersion medium; ϕ the relative volume of the disperse phase; K a constant which depends on the nature of the dispersion medium, disperse phase and temperature) is valid for erythrocyte suspensions. It is also valid for a large majority of solutions (practically through their range of solubility), as well as for blood sera, but in these cases ϕ is a multiple of the concentration ($\phi = nc$). Consequently it is permissible to say that these solutions behave *as if* each unit of the solute occupied a space corresponding to η.

Both the η and the k vary in serial dilutions of different sera but are sufficiently interrelated to permit the equation:

$$n = \left\{ \frac{113}{c} - 1.52 \right\} \log_{10} n/1.015 - 0.66$$

which is valid for all the sera examined and for temperatures from 20° C. to 40° C. For instance a serum containing 7.5 per cent proteins and having at 40° C. a viscosity of 1.70, behaves according to the equation, as if each gram of its proteins occupied or influenced a space of 2.37 cc. Multiplying the n by the coefficient necessary to make it 100 in the average normal human serum, we obtain the VP Index. Thus, a VP Index of 120 means that the examined serum behaves *as if* each gram of its proteins occupied a space by 20 per cent larger than it seems to occupy in a normal serum. In an analogous way, if the concentration of all the colloids of the serum is expressed by their refractometric index, we obtain the VR Index. The VP Index is more sensitive to pathological changes, the VR Index more foolproof, because the determination of the refractometric index is simpler and more reliable than the protein determinations. The standard deviation of the VR Index in health is only ± 2.5 per cent (including the probable error of the method), while its range in disease was found to be from 82 to 157 in the 1500 examinations presented. These sera were obtained partly from the author's own patients with internal diseases, partly from all other branches of medicine, as other physicians gradually learned to value the results. In conjunction with other methods—and never without a clinical examination—they proved useful in revealing the presence of disease, in excluding some diagnoses and in a more precise statement of the therapeutic indications established by McDonagh. Heuristically, the method lead to an extension of the liver treatment to a group of patients who were not anemic but whose blood serum resembled that in pernicious anemia and to the recovery of a patient with the hitherto fatal combination of agranulocytosis with jaundice.

THE MECHANISM AND APPLICATION OF THE FRIES ISOMERIZATION

BY

VLADIMIR C. SEKERA

Northwestern University, Evanston, Illinois

ABSTRACT

At the present time, the Fries reaction is the best means of obtaining the hydroxyaryl ketones which are important in a variety of organic syntheses. Fries and Finck,[1] in their study of the homologs of Cumarone, observed that when the chloroacetates of phenols were heated with aluminum chloride a rearrangement occurred readily and smoothly to the hydroxy-*omega*-chloro-acetophenones.

This rearrangement of the aryl esters of carboxylic acids to hydroxyaryl ketones, as has been indicated by a large number of investigators, may also be accomplished by employing anhydrous ferric chloride and zinc chloride. However, it is apparent that anhydrous aluminum chloride is the most effective reagent for the conversion.

The technique of Fries and Finck was used until Rosenmund and Schnurr[2] recently announced that the Fries method could not be put to general application because of several complications and also observed that when the rearrangement is carried out in nitrobenzene solution a more rapid conversion occurs and in many cases with a better yield of product.

The reaction was generally assumed to be an intramolecular rearrangement of the phenyl ester into the hydroxyaryl ketone until recently when Rosenmund and Schnurr suggested that the reaction must be bimolecular. When they heated a mixture of o-chloro-p-cresyl acetate and p-cresyl benzoate with aluminum chloride for fifteen minutes at 150° C. they obtained all four possible products. An intramolecular change should produce only the two normal compounds o-acetyl-o-chloro-p-cresol and o-benzoyl-p-cresol. The subsequent work of Rosenmund and Lohfert[3] apparently gave further evidence that the Fries shifting does not occur within a single molecule. Auwers and co-workers[4] refuted these arguments and presented evidence to indicate that the Fries reaction is not a saponification and a subsequent resubstitution but a molecular rearrangement. It was reported recently by Cox[5] that some acetyl chloride was obtained when aluminum chloride acted on 2, 4, 6,-trichloro-phenyl acetate. This observation would support the contention that the reaction is bimolecular and that when the phenyl ester is acted upon by aluminum chloride, the free acid chloride is produced, which subsequently reacts with the phenol giving a ketone.

Fries and his co-workers[6] indicated that the reaction is a valuable synthetic method and the work of Auwers and his students[7] not only confirmed this but extended its usefulness to the preparation of a large number of monohydroxy-aryl ketones. Interesting syntheses in the poly-hydroxy-aryl ketone series were accomplished recently by Mauthner[8] employing the Fries method of transformation. It was shown by Fries[9] and later by Lederer[10] that when *alpha*-naphthyl acetate is rearranged by heating with aluminum chloride, 2-aceto-1-naphthol is formed. In the same manner the isomerization of *beta*-naphthyl acetate with aluminum chloride yielded chiefly 1-aceto-2-naphthol.

The Fries reaction has the possibility of becoming important in the commercial preparation of intermediates for antiseptics[11] and dyes.[12] It is also of theoretical interest because of its still uncertain and disputable mechanism.

---

[1] Fries and Finck, Ber., *41*, 4271 (1908).
[2] Rosenmund and Schnurr, Ann., *460*, 56 (1928).
[3] Rosemund and Lohfert, Ber., *61*, 2601 (1928).
[4] Auwers and co-workers, Ber., *61*, 416, 1495 (1928) Ann., *464*, 293 (1928).
[5] Cox, J. Am. Chem. Soc., *52*, 352 (1930).
[6] Fries and co-workers, Ber., *43*, 212 (1910).
[7] Auwers and co-workers, Ber., *54*, 1543 (1921); *58*, 26, 36 (1925). Ann., *408*, 212 (1915).
[8] Mauthner, J. prakt. Chem., *118*, 314 (1928); *136*, 205, 213 (1933).
[9] Fries, Ber., *54*, 709 (1921); *58*, 2835 (1925).
[10] Lederer, J. prakt. Chem., *135*, 49 (1932).
[11] Coulthard, Marshall, and Pyman, J. Chem. Soc., *1930*, 280.
[12] E. P. 248 791 Chem. Zentr., *1927*, (II) 336.

PAPERS IN GEOGRAPHY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

All of the eight papers on the Geography program were given at the section meeting but the following were not presented for publication:

"The relation of topography and drainage to farm-type regions of Illinois," by W. E. Powers and E. C. Dapples, Northwestern University, Evanston.

"Growing broomcorn in Coles County, Illinois," by Rose Zeller, Eastern Illinois State Teachers College, Macomb, Illinois.

Attendance at the meeting averaged forty; maximum attendance was fifty.

Mr. F. W. Cox, Carbondale, Illinois, was elected chairman for 1934-35.

(Signed) ALFRED W. KASEL, *Chairman*

DECATUR, ILLINOIS: A STUDY IN URBAN GEOGRAPHY*

BY

E. MURIEL POGGI

University of Illinois, Urbana, Illinois

There are definite reasons for the location of every city, and most settlements are the result of certain physical conditions. A century or two ago the reasons were more definitely geographical than they are today, because, owing to many and varied inventions man is now able to overcome natural drawbacks, or rather turn what at one time were considered obstacles, to his account. We are all familiar with physical features which have led to the development of a city, such as water power in falls or rapids, as seen at St. Paul and Minneapolis; a portage between two waterways, as at old Fort Dearborn; a convenient site for bridging a river, as at St. Louis. There are many other reasons for settlements, some strategic, as seen in

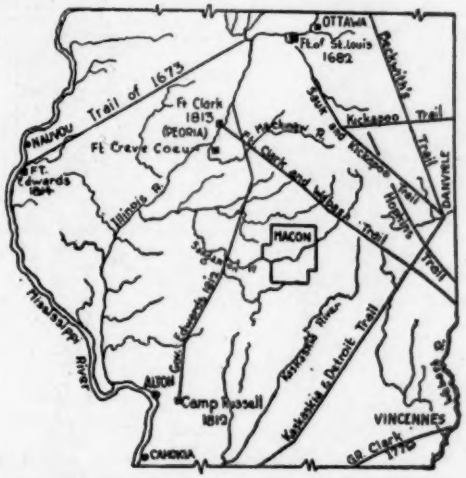


FIG. 1.—Illinois Indian trails *(After Richmond, Mabel E., Centennial History of Decatur and Macon County, p. 12.)*

the site of Quebec, others at the tidal limit of a river as seen in London which was also the lowest point at which the river Thames could be bridged. Oxford was the point on the upper Thames where the river could be forded by oxen. In some cases minerals were the attraction as at the site of Danville, Illinois, where Indian trails converged on salt supplies and on deposits of vermilion clay from which a rich red coloring matter was obtained.

* The writer wishes to acknowledge the valuable assistance of Mr. Royal B. McClelland of the Decatur Association of Commerce, and access to the Association's files. Mr. M. E. Lockhart of Niantic supplied the writer with first-hand information on land utilization and early development of the Decatur area.

In central Illinois there is such a sameness in the natural landscape and so few outstanding physical features that it is not always easy for the geographer to account for the location of settlements. The pioneer, however, was on the lookout for certain necessary requirements in choosing a site

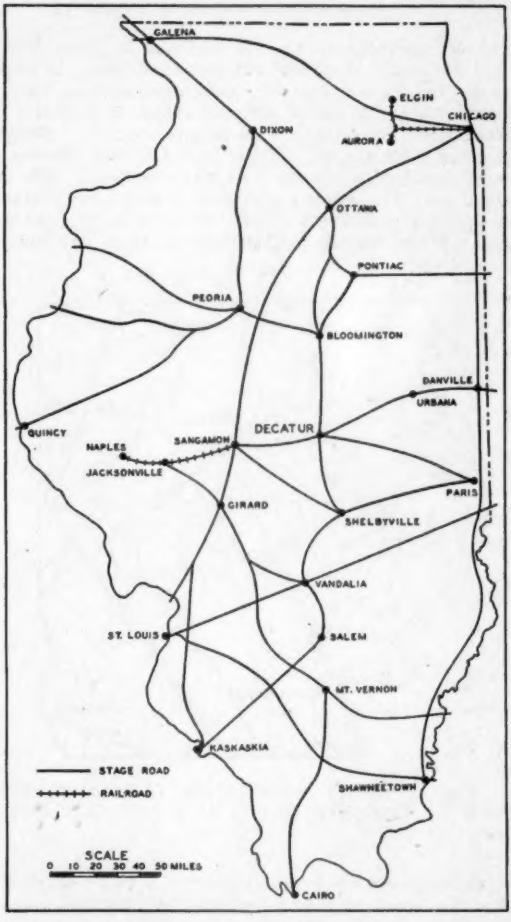


FIG. 2.—Stage routes in 1851 *(After Richmond, Mabel E., Centennial History of Decatur and Macon County, p. 98.)*

for his homestead, for example, a supply of good drinking water besides water for domestic purposes, timber for buildings, and fuel. If in addition to these there was good land for grazing and crops, access to means of transportation and power supplies, the site was considered especially attractive.

In any urban study the first consideration is an attempt to account for the original location of the settlement in question; so in the case of Decatur, we begin by consulting the historian and noting, very briefly, the chief steps which led to the establishment of the town site.

Early Location and Development of the City Pattern

Illinois was admitted to the Union in 1818 with a population of about 35,000. Settlement was mainly along the wooded stream banks where there were supplies of timber for building material and for fuel, together with shade for cattle and a good water supply. On account of poor drainage the prairies were often inaccessible and unhealthful; so that even the Indian trails (Fig. 1) avoided them.

John Stevens settled three miles northwest of Decatur on the stream named for him about 1822. About 1824 the Ward family from Kentucky settled not far from the Sangamon River, to the south of where Lake Decatur lies today. Several families soon joined the Ward settlement, so that a little hamlet started here on the banks of the Sangamon. After Illinois was admitted to the Union the General Assembly began establishing roads. In 1824 men were named to "view, survey and locate" the first road to cross

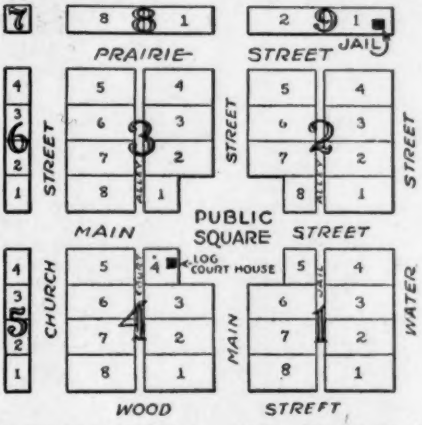


Fig. 3.—Plat of Decatur *(After Richmond, Mabel E., Centennial History of Decatur and Macon County, p. 26.)*

Macon County, which was the Springfield-Paris road. It ran several miles south of Decatur; but the route was changed, and in 1833 the Decatur-Springfield Road, which corresponds approximately to West Main Street and Route 10 of today, was laid out.[1]

In 1829 the route for a second road in this area was surveyed. This was from Shelbyville through Ward's settlement and thence across Tazewell County to the mouth of the Big Vermilion on the Illinois River.[2] The laying of east-west and north-south roads which crossed at Decatur gave an impetus to settlement so that many families were established there by the end of 1829. The territory now known as Macon County was at that time attached to Shelby County, and the county seat was Shelbyville. With the increase in the number of newcomers on either side of the Sangamon it

[1] Richmond, Mabel. Cent. History of Decatur and Macon County, Decatur Review, Decatur, Ill., 1930, p. 15.
[2] *Ibid.*, p. 21.

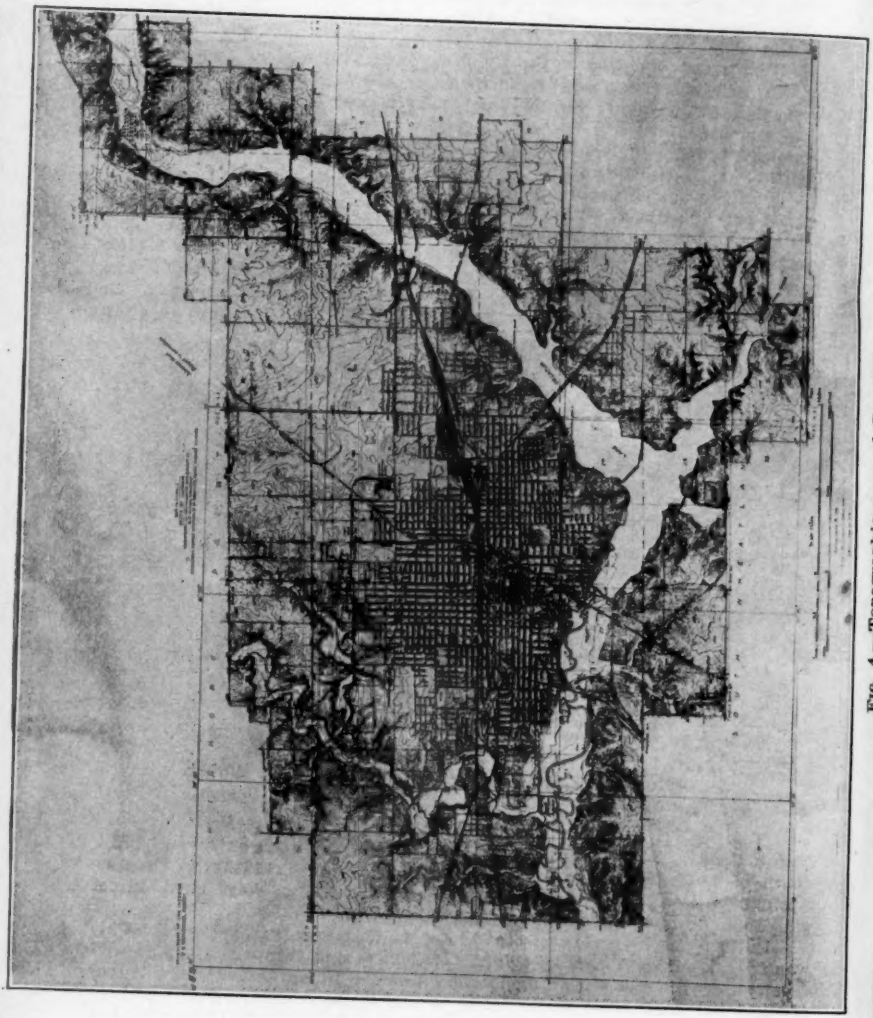
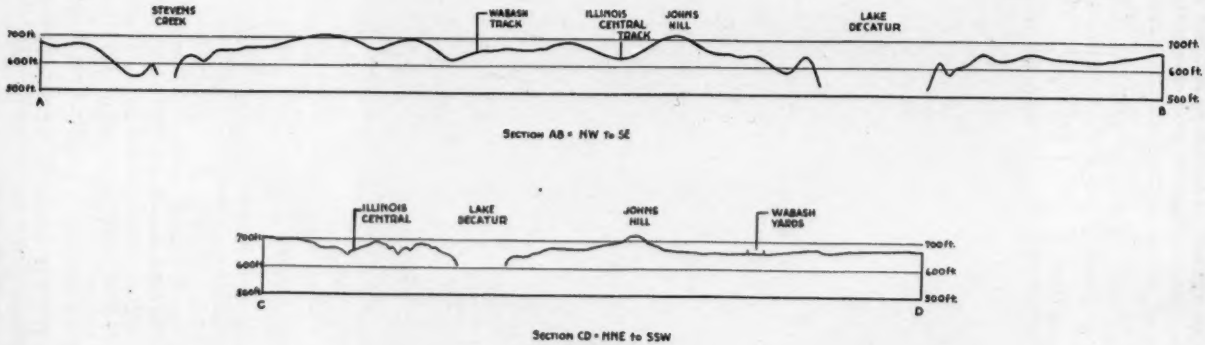


FIG. 4.—Topographic map of Decatur.

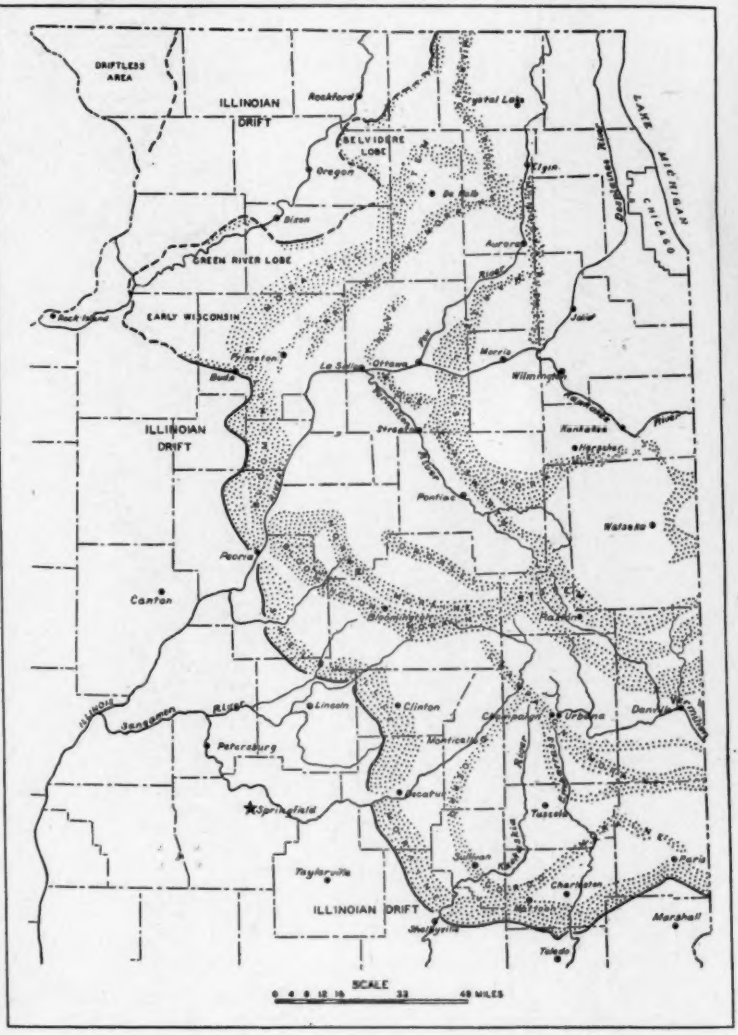
FIG. 4.—Topographic map of Decatur.



SECTIONS ACROSS DECATUR

FIG. 5.

was decided to form a new county and to have a county seat nearer home. So it came about that the original town of Decatur was platted after the



—Courtesy Illinois State Geological Survey.

Fig. 6.—The glacial moraines of northeastern Illinois.

form of Shelbyville (Fig. 3). The names of the boundary streets, Wood Street on the south and Prairie Street on the north, were significant, the edge of the timber reaching to Wood Street.[3]

[3] *Ibid.*, pp. 24-26.

A casual glance at the topographic map might cause one to ask why the original plat was not laid nearer the river, but closer inspection of the surroundings makes it clear that the best site was chosen. It is comparatively high, on rich soil, just to the north edge of the belt of rough timber soil which slopes down to the present lake. Much of this land is not utilized for buildings even today, and can be seen in Lincoln Park, Greenwood Cemetery, Decatur Park District, and so on (Fig. 4, Topographic Map, and Fig. 5, Profiles).

—*Courtesy Decatur Association of Commerce.*

FIG. 7.—Airplane map of Decatur and vicinity.

PHYSICAL BACKGROUND

1. Soil.—In studying the early development of Decatur the physical background is of primary importance as the most valuable natural resource—the soil—is the result of the physical conditions. These conditions are really an epitome of the glacial history of this part of the country. A discussion of the glacial geology of the Decatur area is outside the scope of this paper; it will be sufficient to state briefly that Decatur is situated on the eastern border of the Shelbyville Moraine which forms the southern and western boundary of the Wisconsin glaciation in the state (Fig. 6, Map of the Moraines of the Wisconsin Glaciation). The Sangamon valley swings round the east and south of the city, and Stevens Creek joins the Sangamon River to the west of the present residential section (Fig. 7, Airplane View of Decatur and Fig. 4, Topographic Map).

Macon County is, geologically speaking, very young, the Wisconsin ice sheet being the last to come down over the state. The soil retains a large proportion of plant foods originally present in the parent soil, and limestone, which is readily leached, is still present in abundance in the subsoil. The county soil map shows that Decatur is situated on the Upland Prairie soil of the Wisconsin glaciation. The less fertile timber soils extend along the banks of the rivers.[4] As we have seen, the early town plat avoided these and the pioneers who settled first along the streams moved on to the better prairie soil soon after the town plat was laid.[5]

The land values in Macon County are among the highest in Illinois. In 1920 when land values reached the highest peak and the average for the State was $164.20 per acre, the average for Macon County was just under $300.00 per acre ($298.99). Even in 1930 when the State average had dropped to $83.24 per acre, Macon County average stood at $142.59. Only three counties, Cook, DuPage and Lake, all of which are in the Chicago area, have higher land values than Macon County.[6]

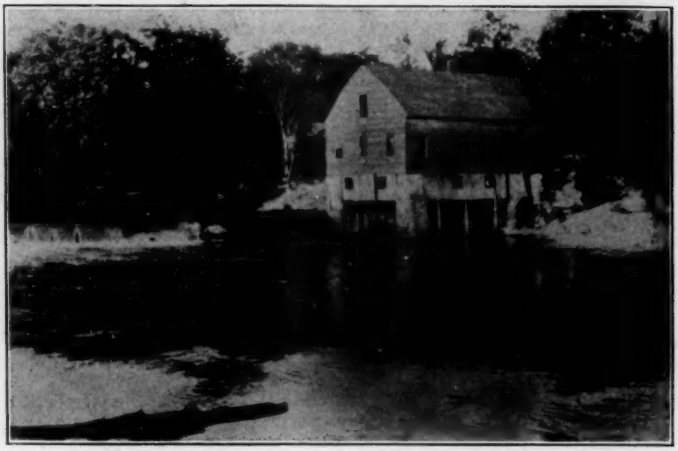


FIG. 8.—Smith's Mill.

2. *Water Supply.*—(a) *Domestic.* Decatur owes much to glaciation; in addition to the rich morainic soil put down by the ice, the glacial sands are the source of pure drinking water. There is an especially good supply of underground water in the west section of the town along the Wabash tracks, which the Polar Ice Plant and the Decatur Ice Cream Company tap. Inhabitants speak of there being an "underground lake" here, but well borings have proved it to be a lense of glacial sand and gravel. Water was also pumped from the river but towards the end of the 19th century the available supply was not sufficient for the increased needs of industrial plants in the city. Projects were considered for the damming of the river to form a lake. The floodplain of the Sangamon, 150-200 feet wide, which had developed in the sand and gravel of a valley train left by the glacial waters, was dammed in 1923 to form a lake 13 miles long, which is now the chief source of the city's water supply, as well as being of great value for recreational purposes. Enough water is impounded in this way to last the city two years without a drop of rain.

[4] U. of I. Agric. Exp. Stat. County Soil Report. No. 45, 1929.
[5] Interview with Mr. Clarence Deakins, James Millikin University, Decatur, Feb., 1934.
[6] Fifteenth Census of U. S. 1930.

(b) *Power.* Waterways were of importance to the early settlers, not only on account of the adjoining woodland but also for power, as coal was not mined until 1881. The streams were sluggish and there were no falls, so that dams were built to supply power for the mills. There were several of these for grinding grain. Smith's Mill on the Sangamon, near Mt. Auburn, about half a mile from the old Lincoln Trail, now the Springfield Post Road, ground corn and wheat (Fig. 8, view of Smith's Mill). Coulter's Mill about three miles above the headwaters of the present Lake Decatur, and remembered by some of the oldest inhabitants, was also a grist mill. There were many other small establishments of this kind along the river banks.

3. Minerals.—Mineral wealth, so great in other parts of the State, was not an early attraction in the Decatur area. At first the local timber supplies were sufficient for building material and fuel. As the village increased in size, bricks were hauled in, mostly from St. Louis and Edgar County. In 1852, however, William Martin began the manufacture of brick in Decatur.[7]

The lime and clay deposits of Decatur were accessible and sufficient for local needs until rail facilities made it possible to obtain a greater variety of bricks from Danville and stone from out-of-state quarries. Coal was first discovered in Decatur in 1874, but shafts were not sunk until 1881, when the Decatur Coal Company was organized.[8] At present the Macon County Coal Company works the one mine in Decatur, and supplies coal for domestic purposes in the city; some is also shipped out to nearby towns. The one shaft which is 625 feet deep, is at 700 South Main Street where the coal seam is 4½ feet thick.[9] The output has decreased somewhat in recent years. In 1927 it was 128,220 tons and in 1931 it had dropped to 82,274 tons. It did not operate in 1932 but now is working full time and employing 340 men.[10]

4. Native Vegetation.—Until 1830 the prairies were unsettled. In the decade 1830-1840 prairie land was commonly sold for $5.00 per acre and often less, and woodland for $35.00 per acre, as at that time timber was the only building material and supply of fuel. During this decade, however, the value of the prairies for cropland came to be realized; this fact did not affect the need for timber and the value of woodland, but by 1856, owing to the development of rail and water transportation, coal, wood and other building materials could be brought to the prairies, and land values were reversed—prairie land advanced to $50.00 per acre and the $50.00 timberland dropped to $25.00 per acre. Woodland came to be regarded as an encumbrance, and was used for grazing or cleared for crops.[11]

Growth of Decatur Before the Railroads

1. Agriculture and Early Industries.—Although the population of Decatur was scarcely 600 at the time, by 1839, several industries had been started. One of the most interesting was the ox mill for grinding corn, located where the Town Branch now crosses East Prairie Street at Broadway. An establishment which was saw mill, grist mill and carding factory, all in one, was opened in 1839. There was also a saddlery and harness shop, a distillery, and a chair factory. These few examples are sufficient to show that the early industries in Decatur grew out of the needs of the settlers in the immediate locality. Lack of transportation in the thirties made it almost impossible to obtain these necessities, much less any luxuries, from a distance. Apart from these little factories and shops, most of the people worked on the land. Crops and livestock were of primary importance, and each household had to be self-sufficient.

Review, Decatur, Ill., 1930, pp. 189 and 191.

[8] *Ibid.*, pp. 287 and 328.

[9] Interview with Mr. D. W. Beggs, General Manager, Macon County Coal Co.

[10] Information supplied by Mr. E. T. Benson, Ill. State Geol. Survey, Urbana, Ill.

[11] Telford, C. J., Third Report on a Forestry Survey of Illinois. Ill. Nat. Hist. Survey, Urbana, Ill., 1926, pp. 6 and 7.

As we have seen, it was in the decade 1830-1840 that the great fertility of the prairie came to be realized. In 1833 the first plow was invented which could cut the prairie sod. John Deere started making these, using old steel saws for plow shares. He established the factory at Moline which still bears his name.[12] Crop yields of corn, wheat, barley, oats and flax were high and the indigenous blue stem grass and white clover were fine fodder for cattle; fruit and vegetables were plentiful, and from all accounts the Decatur farmers in 1840 were well fed and prosperous, so much so that they were continually agitating for means of transportation to market an increasing surplus of their farm products.

2. *Transportation.*—In the forties, Illinois had various detached beginnings of the railroads, but owing to the lack of funds none of these was completed, except the Northern Cross Railroad from Meredosia, on the Illinois River, to Jacksonville, which was extended, by private capital, to Springfield in 1842.[13] As the schemes for railroads and waterways had failed, highway travel increased with the increasing agricultural surplus. The roads, however, were very poor and there was no system for maintaining or improving them (Fig. 2, map of Illinois showing stage routes in 1851).

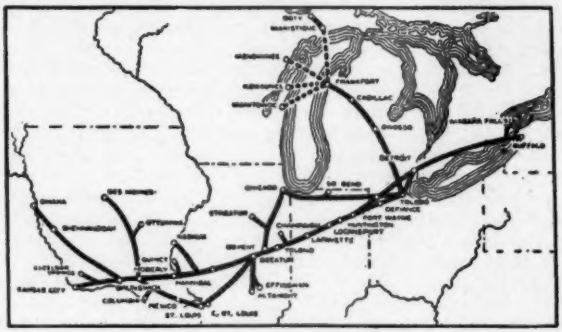


FIG. 9.—Map of Wabash Railroad.

THE COMING OF THE RAILROADS

1. *Two Main Lines Cross at Decatur.*—In 1854 the entire population of Decatur turned out to witness the coming of the first railroad train. The greatest need of this town for twenty-five years had been transportation, either water or rail, and at last its hopes were realized! The coming of that Wabash train had been eagerly anticipated for months. Two railroads had been racing to Decatur, each the extension of a large railway system. They arrived almost simultaneously, the Wabash and the Illinois Central.

As we have seen, railroad history in Illinois began with the Northern Cross Railroad in 1837, which reached Decatur in 1854. During these years another pioneer railroad was pushed to the southwest out of Toledo. The two roads were ultimately brought together and incorporated as the Toledo, Wabash and Western and was finally known as the Wabash Railroad (Fig. 9, map of Wabash Railroad).

The Illinois Central Railroad Company was incorporated in 1851, and a few years later the road was completed and in operation between Cairo and Dunleith on Mississippi River. When the first train on the Illinois Central

[12] Information supplied by Prof. R. I. Shawl, Dept. of Agric. Engineering, Univ. of Ill., Urbana, Ill.

[13] Richmond, Mabel. Cent. Hist. of Decatur, p. 79.

line entered Decatur, the city became the crossing place of these two great lines, the Wabash and the Illinois Central. The Union Depot was built at the point of intersection, to be used by both companies. Decatur was established as a railroad center and her future was assured.

2. Immediate Effects of the Railroads.—The immediate effect of the railroads on the growth of the city may be seen in the population increase in the decade 1850-1860, from 600 to nearly 4,000. This increase began a few years before the railroads were started when it was rumored that the lines would pass through Decatur. The years 1856 and 1857 marked the arrival of two men whose names were to loom large in the industrial history of Decatur. These were David S. Shellabarger, who developed the milling industry, and Hieronymus Mueller, who opened a small gun shop on West Main

FIG. 10.—First map of Illinois Central Railroad *(After Richmond, Mabel E., Centennial History of Decatur and Macon County, p. 211.)*

Street where he made and repaired guns. His flint-lock gun was soon much in demand as Macon County was then well supplied with game, the materials used for gun construction being brought by rail from the Middle Atlantic States.[34] The success of these two concerns was largely due to the transportation facilities which made it possible for products of the Shellabarger Mills to be easily and cheaply marketed, and enabled Mueller to obtain materials for his gun shop, to which he soon added plumbers' repairs and hardware.

[34] Roche, J. W. Industrial Relations in Three Decatur Plants—Staley's, Mueller's and the Wabash Shops. M. A. Thesis in Economics, Univ. of Illinois., 1932, p. 3.

3. Progress of Industry Backed by Agriculture.—By 1860 Illinois had become the center of the agricultural life of the nation. During the Civil War the demand for foodstuffs for the Union armies, together with poor European harvests, served to stimulate prices. There was a withdrawal of a quarter of a million workers, mainly from the farms of the State, to joint the Union forces, so the use of farm machinery increased greatly.[25] Decatur, being in the midst of the richest farming section, it was there that several inventions in connection with farm machinery were made or improved at this time. Haworth invented the check rower and corn planter. Barber and Hawley opened a plant for the manufacture of gang plows, cultivators and other agricultural implements. John Beall invented his corn sheller in 1864 and started its manufacture. In 1867 a linseed oil mill was started which, together with other smaller concerns,[26] based on agricultural products and aided by good transportation, showed that industry was progressing steadily with agriculture. While the farmers were selling the products of the soil, the manufacturers were busy providing the farm implements.

The Present Day City

1. City Expansion and Increase of Industries.—In 1900 the population of Decatur was nearly 21,000 and by 1930 it had increased to 57,510. The population curve is a normal one, as seen in comparison with those of other U. S. cities of the same size, for example, Cedar Rapids, Iowa, and Springfield, Missouri. Along with the increase in population the city pattern has become star-shaped as a result of what is termed "axial growth."[27] During the periods of city expansion there have been adjustments to the physical conditions which have resulted in elongated star points to the east and west. A comparison of the maps of the electoral divisions of the city for 1907 and 1927 brings out this east-west extension: the industrial section on the east and the residential section on the west.

The old Union Depot, as we have seen, was built at the intersection of the Illinois Central and Wabash lines, near what was then (1855), the eastern boundary of the city. Later the Wabash roundhouse and shops utilized, as an ideal site, the level stretches of land east of the depot, along the Wabash tracks (Figs. 4 and 5). Attracted by the railroad facilities, Staley's, Mueller's, the Mississippi Structural Steel, the Decatur Brass Works, and many other industrial concerns, built their factories in this section, which is now fringed with the small dwellings of the industrial workers.

In 1900 James Millikin presented Oakland Park, on the western edge of the city to Decatur as the grounds for the university which was named after him. Later the Anna B. Millikin Home and the Art Institute were built in this district. These fine buildings with their beautiful grounds drew residents to this section who could afford to build comfortable homes in attractive gardens. Farview Park and the wooded banks of Stevens Creek add beauty to this western extension of the city, and owing to the direction of the prevailing winds, the west of the town is cleaner than the east side, the smoke and soot from the factories being carried eastward away from the city, so the star points extending out to the west and northwest are today considered the best residential sections.

2. Growth of Industries.—The Census of Manufactures in 1929 gave reports of 100 Decatur industrial establishments, with products valued at more than $52,000,000. Of these concerns the three that employ the largest number of workers are the Wabash Locomotive and Car Shops, the Mueller Manufacturing Company, and the Staley Manufacturing Company. As be-

[25] Poggi, E. Muriel. Settlement and Development of the Prairie Province of Illinois. Ill. State Acad. of Sci. Trans. V. 24, No. 2, 1931, pp. 401-409.
[26] Richmond, Mabel. Cent. Hist. of Decatur, pp. 265-266.
[27] Dorau, H. B. and Hinman, A. C. Urban Land Economics, Macmillan, 1928, pp. 62-64.

fore stated the Wabash Railroad reached Decatur in 1854 and the line from Decatur to St. Louis was built in 1869. In that year the first Wabash roundhouse was built in Decatur. In 1884 the Wabash Car Shops were moved there from Peoria. Since that time Wabash interests have increased in Decatur, which has since been called "the hub of the Wabash" with spokes radiating to Kansas City, St. Louis, Chicago, and Buffalo. Through Decatur important freight is routed from Kansas City to Buffalo without entering the congested terminals of Chicago or St. Louis.

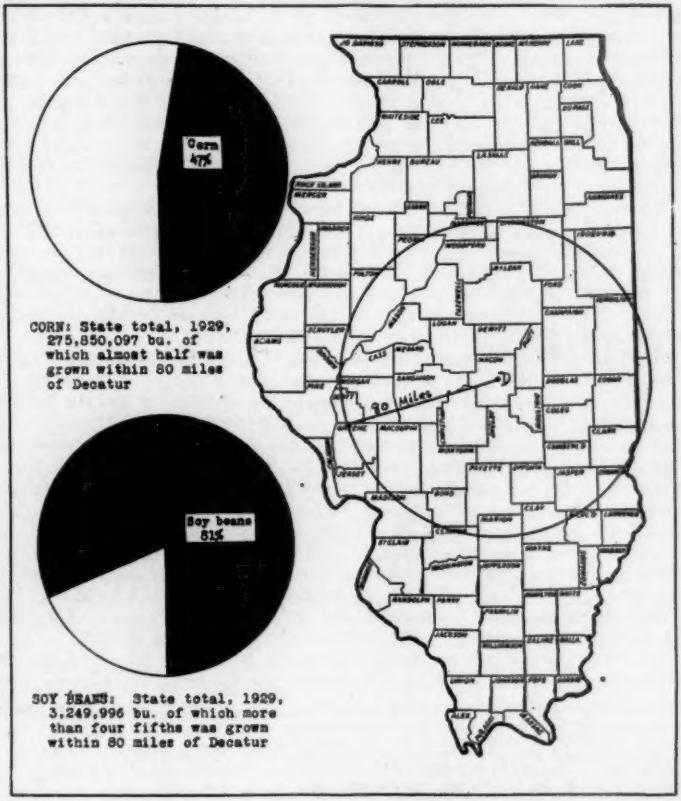

Corn
47%
CORN: State total, 1929, 275,850,097 bu. of which almost half was grown within 80 miles of Decatur
Soy beans
51%
SOY BEANS: State total, 1929, 3,249,996 bu. of which more than four fifths was grown within 80 miles of Decatur
80 Miles

FIG. 11.—Map showing corn and soybean production within 80 miles of Decatur.

Hieronymus Mueller established his gun shop in Decatur soon after the railroads reached the city. It is largely due to the transportation facilities that this little business has become the great manufacturing plant that it is today. From gun repairs, plumbers' supplies, hardware, to his water main tapping machine, gas main taps and all kinds of faucets, the variety of products has increased, the large section which manufactures vitreous ware being one of the company's latest additions. The Mueller Company supplies what are termed "capital goods", that is goods made for long service, and

requiring a small amount of material but much skill. Fuel supplies and raw materials are assembled from many distant fields, but the value added by manufacture together with favorable freight rates makes this profitable. The tonnage of incoming freight to Muellers is about nine times as great as the outgoing freight.[18]

The Staley Company was founded much later than the Mueller Company and under different circumstances. Mr. A. E. Staley bought a bankrupt factory in Decatur in 1909. Before he did this, however, he was familiar with the city and the agricultural resources of the surrounding country.[19] The original plant covered only a small acreage, but at the present time the company owns 382 acres in Decatur and 72 acres in Peoria.[20] In 1912 corn grinding operations began with a capacity grind of 1,000 bushels a day, the manufactures being pearl and powdered starch, crude oil and gluten feed. Since then other products have been added until today with a grind capacity of 50,000 bushels per day they are manufacturing, packing and shipping 70 or more varieties and fluidities of starch alone, to say nothing of many other products, such as corn sirups, sugars, paper mill products, salad and cooking oils, soy bean products, and candies.[21]

The location of the Staley plant is an excellent one from both geographic and economic points of view. The Bureau of Census Reports show that for the past 40 years the center of corn production has been in the state of Illinois, and within a distance of 60 miles of Decatur.[22] The accompanying map (Fig. 11) shows the part of the state within a radius of 80 miles of Decatur. This area produced 130,911,403 bushels of corn in 1929, or almost one-half of the corn produced in the state for that year.[23]

The manufacture of soy bean products is a recent development. It is an adaptation to the trend towards greater diversification of crops in the Corn Belt. The recent increase in acreage and production of the soy bean in Illinois is very marked. The production for the whole state in 1919 was only 23,812 bushels; in 1929 it had risen to 3,249,996 bushels, more than two-thirds of which (2,643,462 bushels) were raised within a radius of 80 miles of Decatur.[24] The grind of the industry would have been considerably higher during the last few years if the bean crop had been larger.[25]

Staley's has in operation an elevator with a storage capacity of over 4,000,000 bushels of grain; in addition transportation facilities are such that Decatur can receive shipments from all the grain receiving centers within a maximum of three days. Should there be a shortage in the local supplies, the markets of St. Louis, Chicago, Indianapolis and Peoria can supply grain to Decatur within 24 hours, while Omaha is but three days distant.

3. *Decatur as a Grain Market.*—Decatur is one of the four leading markets for Illinois corn; Chicago, St. Louis, Peoria being the others. This

[18] Interview with Mr. E. H. Langdon, Mueller Co., Decatur, Feb. 17, 1934. Some of Mueller's supplies and their sources are as follows:
Coal obtained chiefly from Pana, Ill. and Kentucky.
Coke obtained chiefly from Indianapolis and West Virginia.
Fuel Oil is piped from Texas.
Copper from the Great Lakes Region.
Iron from St. Louis and Chicago.
Abrasives from Niagara.
Tin from Malaya via London.
Ball Clay from England.
Kaolin from Georgia.
Flint from N. Illinois near Ottawa.

[19] See Pamphlet by Staley Manufacturing Co., "To Our Better Acquaintance," pp. 1-5.

[20] Roche, J. W. Industrial Relations in Three Decatur Plants. U. of I. Thesis, 1932, pp. 7 and 8.

[21] *Ibid.*

[22] Wylie, Clifton J. Decatur as a Location for a Corn Cereal Mill. Thesis, School of Commerce and Finance, James Millikin University, Decatur, 1925.

[23] Fifteenth Census of U. S., 1930.

[24] Fifteenth Census of U. S., 1930.

[25] Information supplied by Mr. E. K. Scheiter, Pres. Staley Sales Corporation, April 10, 1934.

is largely due to the fact that Staley's Plant is located here, and also to the city's development as a distributing point for grain. Decatur was reported as handling about 25 per cent of the corn shipments from the central area during each year, as well as a considerable quantity of corn from conveniently located points in other areas, as the results of transportation facilities and low freight rates.[36]

4. *Decatur as a Route Center.*—In spite of the fact that poor transportation was the greatest drawback to the early development of Decatur, the city has become a railroad center of considerable importance in the state. Five railways serve the city; the Wabash, the Illinois Central, the Baltimore and Ohio, the Pennsylvania, and the Illinois Terminal System (electric). As we have seen, the main lines of the Illinois Central run from north to south across the state, while the Wabash lines extend generally in an east-west direction. Taking the records for a day in February, 1934, the total of all Wabash trains entering and leaving Decatur was 85.[37] On the Illinois Central lines the total number of trains passing through Decatur daily is scheduled as 22.[38] Decatur is on the lines of five state paved road routes. Two of these are Federal Routes, one being part of the U. S. Highway 51, from Lake Superior to the Gulf, and others being sections of U. S. Highway 36, from Colorado to the Atlantic.

In 1830 the farmers of Decatur were clamoring for more and better roads. One hundred years later the communication lines which converged on Decatur proved to be the city's greatest asset. Man's adjustment is seen in his development of the nodality of this rich prairie section to such an extent that industries were established that were not necessarily dependent on products of the prairie, but were attracted to, and made prosperous by that nodality.

Conclusions

It cannot be said for Decatur that its location is the result of any of the interesting physical conditions that were referred to in the opening paragraphs, but it may be claimed that the site was the result of a "geographic accident". There were no doubt many locations in the strip of prairie surveyed by the Illinois Central Company that were just as suitable for settlement as Decatur, but when the east-west line of the Wabash crossed the north-south line of the Illinois Central in 1854, Decatur received an impetus to development that was denied to the villages to the north or south.

This route convergence added value to the fertile cropland, making it possible to market an increasing surplus of grain. As industries based upon agriculture, and later, manufactures independent of agriculture, have developed, it appears that Decatur's prosperity is more dependent on the railroads than on anything else. Some cities of Decatur's size have recently become less dependent on the railroads owing to the development of bus and air transportation: Decatur cannot do this to any extent. Owing to her type of industries, the railroads are essential.

The city has suffered more than many others during the depression because of the important part played by the railroads in its economic life. Even the corn-products plant, the location of which was the direct result of the geographic environment, is now just as dependent on the railroads as any of the other industries, as it has outgrown the corn supplies of the immediate locality, and, together with the other industrial plants, depends largely upon the railroads for its existence. So although Decatur is served by an excellent system of hard roads and has the beginnings of two airports, the railroads have been, and still continue to be her salvation.

[36] Stewart, C. L. et al. Market Destinations of Illinois Grain. U. of I. Agric. Exp. Sta. Bull. 315, 1928, p. 86.

[37] Fifty-five manifest freight, 18 local freight, 12 passenger trains. Interview with Mr. Harold Eislie, February 17, 1934.

[38] Four passenger, 4 local freight, 14 manifest freight. Information supplied by Mr. L. C. Snell, I. C. Railroad, Decatur.

THE RETARDED DEVELOPMENT OF ALASKA

BY

EMMA AYRS

Northwestern University, Evanston, Illinois

Despite the glowing accounts of Alaska's rich resources, they remain undeveloped, and the geographer naturally looks for the underlying causes.

Undoubtedly, Alaska is rich in natural resources. During the forty years preceding 1925, $500,000,000 worth of fish were caught in Alaskan waters, and up until the end of 1929, $616,000,000 worth of minerals had been mined in Alaska.

Furs constitute a third important source of wealth, wild game alone furnishing about $2,000,000 annually. Fur farming also seems to hold out unusual possibilities. The reindeer herds are increasing at the rate of 39 per cent a year and it is estimated that when the full capacity of the northern herd is reached, there will be available each year for market approximately 200,000,000 pounds. The fur seals of the Pribilof Islands are also steadily increasing in numbers.

In 1932, the timber stand was estimated to be 85,000,000 board feet and lumber cut from the National Forests on a sustained yield basis amounts to about 40,000,000 to 50,000,000 board feet per year.

Because of these resources, the outlook for the Territory has been considered brighter than that for more fully developed European countries lying in approximately the same latitude. But are these indications that Alaska is actually progressing?

In the vast area, 586,000 miles in extent, there are but 59,278 people (51 per cent of whom are Indian and Eskimo, and more than 3/5 of whom are found in the southern part of the country). In 1930, there were the same number of native whites as in 1910 and only half as many foreign born inhabitants. Native stocks alone showed an increase. Hence one questions whether conditions in Alaska are suitable for a permanent people.

Alaska as a whole has 64,000,000 acres available for agriculture and grazing, and Alaskan soils and climate permit crops of potatoes, hardy vegetables etc. It therefore seems that a closed economy might be possible though there is little hope for developing a market economy. However, if Alaska cannot attract immigrants and no dependence can be placed in the slow increase of native stocks, the development of the country will have to be exploitive.

Yet before accepting as inevitable such a distasteful prospect as mere exploitation, it is worthwhile to consider why Alaska has failed to come up to expectations. Is it because of the inaccessibility of resources, poor governmental management, the wrong type of publicity, or the character of the inhabitants?

Since each of these considerations, and perhaps others, may have some bearing on Alaska's present situation, what is a fair and impartial attitude to take? Alaska's position in the far north off of all established trade routes, its great distance from the more densely populated sections of the United States, and the great mountain range preventing easy access from the south combine to form what is probably Alaska's greatest hindrance, isolation. Nevertheless, there is no apparent reason why slow, but long continued growth should not culminate in the ultimate development of the Territory in the future when it may be much needed as an essential aid in supplying world demand.

TEN POINTS OF EMPHASIS IN THE GEOGRAPHY OF ILLINOIS

BY

W. O. BLANCHARD

University of Illinois, Urbana, Illinois

Problem: The economic importance of the state is far greater than its area would suggest. Of only average size, it is third in population and third in value of annual output of goods among the states (1933). The output is almost equal to the total of the three Pacific states and more than all six New England states combined. Why?

1. The state occupies a bridge between two of the world's greatest inland waterways, and has the lowest portage joining them. It has (1) 1,000 miles of navigable water and (2) access to the ocean via either of the two routes.

2. Its wealth and its transit position help to give the state high rank in transport facilities by land, water, and air. It ranks second in railway mileage in proportion to area, as well as in total mileage. In proportion to area and population it exceeds Germany or France. It ranks high in mileage of hard road with 10,600 miles of concrete; its roads are used by 1.6 million cars. Deep waterways projects via Mississippi and via St. Lawrence promise much greater use of the waterways. Chicago is the leading center for U. S. air line transport.

3. Topographically it is (1) level and (2) low. Third flattest state, and it averages only 600 feet, with small relief. This is important to (1) agriculture, (2) transport, (3) climate, (4) drainage.

4. The climate is favorable for people and agriculture—especially for corn. Note influence of (1) relief, (2) continental interior location, (3) latitude, (4) cyclonic storm track. Within the state variations of climate are dependent upon latitude; the southern part is warmer and wetter. A difference of 50 days exists in the average growing season from north to south in the state.

5. Soil is by far the most important resource. It is exceptionally fertile in north and center, due to (1) youth, (2) rich parent stock, (3) favorable climate. Soil in the southern part is less fertile.

6. Illinois is rich in coal, clay, sand and gravel and limestone, with modest quantities of petroleum, lead, and fluorspar. Coal underlies ⅔ of the state, accounts for over 4/5 of the total mine and quarry products, and in production usually ranks third among all states. The reserves are some larger than those of Great Britain. Though of non-coking grade, the coal is fundamental to the industrial and commercial activities. A declining petroleum production is now equivalent to over a million tons of coal a year, the water power to less than one-half million tons of coal.

7. Illinois is one of the leading agricultural states. In total agricultural output it ranks third; in proportion of the state cultivated it is second. A favorable climate, level surface, and fertile soil supply a remarkable combination.

Corn dominates the farm economy covering over 2/5 of the acreage and over ½ of the value of all the crops. Oats occupy 20 per cent, hay 15 per cent and wheat, 11 per cent (1929). These support vast numbers of swine and cattle. Dairying, confined chiefly to the north, constitutes ¼ of the cash income of all the state agricultural activities.

8. Illinois ranks third among the states in manufacturing with a net value almost twice as much as that of Canada. Manufacturing employs over twice the number of people and yields over three times the returns of agriculture.

Easy access to a great variety of raw materials and power resources as well as to great markets favored this development. The agricultural setting shows its influence in the importance of slaughtering and meat packing, farm implements and milling.

The concentration of manufacturing in the northeast, especially in the Chicago area is notable. That city accounts for about 60 per cent of the total for the state.

9. Chicago is among the four or five largest cities of the world and second only to New York in the New World. Its rapid growth has been remarkable. A century ago it was a village of about 20 houses. Almost one-half of the population of the state is in the city and it has more people than such whole states as Wisconsin, Minnesota, Iowa or Kentucky.

Its location at the end of Lake Michigan has been all important as well as its general location in a highly productive section of the United States. It is primarily industrial but commercial interests are well developed. It is the world's greatest grain, live stock, produce and lumber market as well as the leading railway and air line center.

10. Last, but not least, the presence of an intelligent, energetic population capable of exploiting the resources and improving the environment to fit man's need. Contrast the status of the region with the same environmental lay-out, but an Indian population. The possibilities for further improvement are enormous, especially in our agricultural and mining methods.

THE GEOGRAPHY OF THE TOBACCO REGION OF SOUTHERN WISCONSIN

BY

H. O. LATHROP

Illinois State Normal University, Normal, Illinois

Tobacco as a commercial crop in Wisconsin is a surprise to most people because the production of tobacco is usually associated with warm climates and long growing seasons. The southern Wisconsin tobacco region is an island of tobacco situated in the midst of middle latitude grains, which, in turn, are supplementary and basic to the dairy industry. The region is a small area of 500 to 600 square miles. In no part of the area is a major portion of the land in tobacco, 8 to 10 per cent being the maximum devoted to it.

Tobacco production and dairying are the primary interests of the farming population of the region. The two interests appear to work well together in their division of labor. The greatest demand for labor in the tobacco fields is in the middle of the day while the dairy industry requires most attention in the morning and late afternoon. In many ways tobacco and dairying are supplementary to each other rather than competitive.

The topography of the region varies considerably in detail in different parts. The northeast portion is characterized by low, scattered, ovoid drumlins, between which lie extensive peat bogs and marshlands. Drumlins are an inconspicuous element of the landscape in the southwestern part of the area. Much of this portion is gently rolling except that portion which extends across the hilly terminal moraine of the Green Bay Glacier. Large areas of original prairie lands are conspicuous by their dark colored soils. The gentle slopes of these prairie soils are the best tobacco lands. About 84 per cent of the land is in crops or rotation pasture. Most of the remainder is in permanent pasture and there is little idle land.

The attention of the farmer is occupied by tobacco from the building and planting of the seed beds in early spring until the tobacco is finally marketed the following winter or spring. Most of the tobacco is of special quality and is produced for cigar binders. Thin tough leaves of uniform quality and color are demanded for this purpose. Such quality tobacco is produced only when careful attention is given to the soil and topography upon which the crop is grown and to the methods of harvesting, curing, and processing the tobacco.

Labor, more than any other one factor, appears to be responsible for the present importance of tobacco in this region. The large amount of hand labor necessary in the production of tobacco and the expert knowledge and skill required to supervise the work appear to be the chief factors which fasten tobacco production on this region. At an early date numerous Norwegian immigrants settled in the region. These people were ignorant of tobacco culture. They had little money, however, to start farming for themselves. Hence, they were employed as laborers or share-men on the tobacco farms which were already in existence. In this way they learned the industry. They have been willing to do the hard, exacting, patient work required by tobacco culture in order to obtain the large returns which it gives. Today, tobacco culture is largely co-extensive with the area occupied by people of Norwegian ancestry.

ITEMS IN THE HAITIAN PATTERN OF OCCUPANCE

BY

ROBERT S. PLATT

University of Chicago, Chicago, Illinois

ABSTRACT

This is a report of reconnaissance in Haiti, focussing attention on two spots selected as typical items in the rural pattern of occupance.

One of these spots is on the coastal lowland near Léogane. Here on a shore terrace at the foot of low hills is a farm of two and a half acres. The soil is fertile alluvium. The temperature is always high, averaging about 80° F. for every month. An annual average precipitation of 45 inches is concentrated mainly in the half year from April to September. During the other half year rainfall is light and the landscape brown and dusty.

More than half of the farm is occupied by tree cotton. In appearance it is more like a thicket than an agricultural field, growing year after year without replanting. The crop is irregular in quality, but is marketable as a cash product. Another patch of ground is occupied by grain sorghum, providing the main item of food. There is also fodder for a few goats, and chickens.

The only building is a one-room hut occupied by the negro farmer and his family. Here life is reduced to simple terms, with slight provision of shelter and clothing and a semi-wild crop entering world trade.

The other example of rural occupance is in the highlands above Pétionville. It is at an elevation of 2500 feet where temperatures are lower than at Léogane, and rainfall is heavier. Here in a narrow valley is a farm of four and a half acres.

The valley bottom and part of the slope are covered by a dense growth of trees and bushes—giant forest trees, below these a mixed stand of fruit trees, and still lower an undergrowth of coffee bushes. The grove has the semblance of a thicket quite as much as does the cotton field of the lowland, although here it is green and shady even in the drier season. The coffee bushes have been planted but are perennials receiving little care. The crop is treated by the simple dry method, and is sold for export. Part of the slope is occupied by grain sorghum and there is incidental fodder for several pigs and chickens.

A house of two rooms is occupied by the negro farmer and his family. Here also life is simple with slight provision of shelter and clothing and a semi-wild crop entering world trade.

Thus two spots represent present occupance in a country of varied agricultural resources, where a highly organized colony of sugar plantations under slavery has been superseded by a less organized nation of small farms occupied by descendants of the plantation slaves.

PATTERN OF THE PORT OF VANCOUVER, BRITISH COLUMBIA

BY

LEAH STEVENS

Eastern Illinois State Teachers College, Charleston, Illinois

The Port of Vancouver, British Columbia, legally includes all of the tide water opening off the Strait of Georgia and to the east of a line drawn through Point Grey and Point Atkinson. The shoreline measures 98 lineal miles. The harbour may be divided into Inner and Outer harbours.

INNER HARBOUR

Inner Harbour, which is almost completely land-locked, is entered from the west by Lion's Gate, 2,000 feet wide. From this First Narrows the harbour widens to 2½ miles and then narrows again to 2,100 feet at the Second Narrows, approximately five miles farther east. Beyond stretches the narrower part of Burrard Inlet with Indian Arm branching northward from it.

Central Port, Harbour Proper—The Harbour Proper, which is the part of Burrard Inlet that extends to Second Narrows, is the only portion of the harbour that is being developed for deep-sea shipping. Along the south shore, from west to east, are located the major piers, wharves, docks, and elevators. Factories are scattered in the district of the major piers; sawmills and shingle mills are in the outer, eastern part.

The Canadian Pacific Railroad Company controls a frontage of 7,200 feet in the west end of the harbour from Mill Ruins to Evans, Coleman, and Evans piers near Main Street, and three of its piers, A. B-C, and D have the choice position on the waterfront. Pier H is only a little less favorably located to the east. Behind the piers are the railway yeards, approximately 700 feet wide. The station is just back of Pier D but at a higher level. In front of the tracks, extending from Pier D to Pier H are extensive quay wharves that cover about one third of the C. P. R. frontage. This company also owns a narrow strip of land and trackage paralleling the south shore of the Inlet from Port Moody on the east to Mill Ruins on the west.

Vancouver Harbour Commissioners own much of the waterfrontage east of the Canadian Pacific property. They own the old Hastings Mill site, Ballantyne Pier, Numbers 1, 2, and 3 Elevators, Lapointe Pier, and a right-of-way between the Canadian Pacific tracks and the Inlet. This property is occupied by the Terminal Railway of the Harbour Commissioners. On the north shore the commissioners own a booming ground and lumber wharf.

Private piers and slips are scattered between the Canadian Pacific property and that owned by the Harbour Commissioners or lie east of the latter property. Most of the slips are crowded into Coal Harbour in the extreme west end, a part of the harbour too shallow for large boats.

The seven exporting elevators, late in development, occupy the east half of the Harbour Proper, all but one on the south shore.

On the north shore is one elevator, one wharf, a few scattered sawmills and shingle mills, and two drydocks.

Inner Burrard Basin and Indian Arm—Inner Basin and Indian Arm are even less developed than the north shore of the Inlet. The hazards of shipping through the bridge at Second Narrows and the steep sides of the inlet, as well as the distance from the sea, have tended to restrict this part of the harbour to scattered lumber and shingle mills and oil refineries.

Outer Harbour

The Outer Harbour consists of English Bay and an arm of the sea, False Creek. English Bay has a rather uniform width of five miles but is open to the west wind so that construction of port facilities would be costly. At present it is used merely as a roadstead and pleasure bay.

False Creek is really the industrial port of Vancouver. This S-shaped arm of the sea cuts off the business section of Vancouver from the principal residential section and suburbs. The east shore has been reclaimed and is used for terminal yards and depots of the Canadian National and Great Northern Railways. The north shore is occupied mainly by the British Columbia Electric yards in the east part and by the Canadian Pacific yards in the west part. The south shore is used almost exclusively by eleven lumber and shingle mills.

PAPERS IN GEOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Fourteen of the seventeen papers on the Geology program were presented at the section meeting. Of those given at the meeting, manuscripts were not presented for publication for the following:

"The age of the so-called Permian beds near Danville, Illinois," by Harold R. Wanless, University of Illinois, Urbana.

"Migmatization in the Sawatch Range, Colorado," by J. T. Stark, Northwestern University, Evanston, Illinois.

"The geological and biological significance of coal beds," by Louis C. McCabe, Illinois State Geological Survey, Urbana.

Average attendance at the meeting was thirty-five, maximum forty-five.

Dr. E. S. Bastin, University of Chicago, Chicago, Illinois, was elected chairman for the year 1934-35.

(Signed) CHAS. H. BEHRE, JR., *Chairman*

RESEARCH ON PALEOZOIC FORMATIONS IN VIRGINIA

BY

ARTHUR BEVAN

Virginia Geological Survey

ABSTRACT

Paleozoic formations are among the most important as well as most interesting rocks in Virginia. They cover more than one-fourth of the State, contain its most valuable mineral resources, and are replete with problems of great scientific and economic importance.

In recent years, the Virginia Geological Survey, partly in cooperation with the United States Geological Survey, has been attacking some of the major problems and attempting to obtain fundamental data of value to science, to industry, and to well-planned community living.

Field work on the first stages of several significant lines of research has been partly completed. A geologic map of the Appalachian Valley in Virginia, on a scale of 1:250,000, was published in 1933. It shows about 60 formations having a total maximum thickness of about 55,000 feet. Several interesting structural features and patterns have been discovered. A comprehensive report is being prepared. Detailed studies have been made in several widely separated districts in the Valley, resulting in much additional information on stratigraphy, structure, sedimentation, ore deposits, and other resources. Many important problems, chiefly of a research nature, are still to be carefully investigated and solved.

Some research studies have been made upon the remnants of Paleozoic sedimentary formations and upon Paleozoic igneous rocks in the Virginia Piedmont, with new interpretations of paleogeography, geologic history, and ore deposition.

A FOUR-HUNDRED ACRE LAKE DISAPPEARS

BY

CLARENCE BONNELL

Harrisburg Township High School, Harrisburg, Illinois

The geolological map of Hardin county, Illinois, shows alluvium deposits covering an area of approximately 700 acres lying mainly in sections 2 and 3 of Township 12 South, Range 9 East. Bulletin No. 41 of the State Geological Survey, "The Geology of Hardin County, Illinois," says, "in a considerable area northwest of Cave in Rock, * * * the drainage is underground through sink holes. * * * It is dotted with sink holes which must connect with underground stream channels which find their outlet through numerous small springs in the county."

Many of these depressions lie in view from the main highway for the first five miles of the distance from Cave in Rock toward Elizabethtown. They may be seen on either side of the road. Others are out of sight in the area lying between this public road and Ohio River which is two and a half miles away. Some sinks are dry, others are dry in some seasons of the year, while still others are permanent ponds or small lakes. Some are small pits as deep as they are broad and many are several rods across. About forty small lakes are shown on the map in addition to the many dry holes through which the rainfall goes directly.

The alluvial area in sections 2 and 3, lying three miles northwest of Cave in Rock, occupies a depression which at times is drained through sinks within it. After a time these outlets become clogged, so that a body of water collects and forms a lake estimated to have an area of 400 acres and a depth of ten to twenty feet. The lake frequently persists through the greater part of a year, sometimes two years, although there are seasons when a crop of corn may be grown on the fertile lake bottom.

In the autumn of 1933, the water drained out completely after remaining for quite a long period. Several truck loads of fish were gathered up and taken to more permanent waters. Catfish predominated, though quite a number of good sized bass were taken and returned to a mine reservoir from which they are thought to have escaped.

My own observations, made at intervals over a period of twenty five years, are that the lake has been in evidence most of that time.

Following the complete emptying of last autumn, it began to fill in midwinter and occupied 80 to 100 acres by April first. Word received near the end of April from a resident whose land is overlapped by the lake was to the effect that the water was going out again.

If this basin would remain permanently dry, some fine corn land would be reclaimed. If it would remain full of water, it would become a valuable fishing and boating resort.

I have found no evidence that the large body of water which leaves so suddenly at times ever finds a final outlet through springs. This leads to the theory that there must be underground channels to the Ohio River which lies at a lower level than the lake bottom. There has been talk of trying to drain the area permanently by cutting a channel through the higher ridge which lies between the basin and the river. The cost might be prohitive. It would be interesting to learn what underground passages might be revealed if such were attempted. The Fredonia limestone, as before stated, has numerous sinks between the river and the lake basin.

The famous cavern at Cave in Rock is thought by some to be the remnant of an outlet from a small basin at the rear of it which now has a surface stream.

THE GLACIOLOGY OF THE DECATUR REGION

BY

M. M. LEIGHTON and G. E. EKBLAW

Illinois State Geological Survey, Urbana, Illinois

ABSTRACT

The drift deposits of the Decatur region have a maximum known thickness of 222 feet and are probably to be referred to three of the ages of the Pleistocene period—the Kansan, the Illinoian, and the Wisconsin. The bedrock surface beneath the drift probably represents a maturely eroded topography developed in "Coal Measures" strata in late Tertiary time. The maximum known relief of this surface, based on well records, is 117 feet. There are no rock outcrops in the Decatur region.

The Kansan drift is not exposed in the Decatur area, but its presence is inferred from numerous exposures south of the Wisconsin terminal moraine. An old coal shaft record from Decatur reports a black soil at a depth of 73 feet. This probably corresponds to the black soil (Yarmouth) exhibited at the top of the Kansan till in exposures further south.

Illinoian drift, covered by 2 or 3 feet of gumbotil and a black soil is exposed in a recent low, wave-cut cliff on the east side of Lake Decatur, at a point just south of State Highway No. 10. There may also be other outcrops further south along the east shore of Lake Decatur. That the Sangamon River valley below Decatur dates back to the Sangamon interglacial age is shown by its greater development west of the Shelbyville moraine and by the old slope of the valley wall with its Sangamon soil on the north side of the river at the site of the dam.

Iowan loess, about 2 feet thick and yellowish in color, is present above the old Sangamon soil in the exposure described above. Its occurrence here so far from the Illinois valley is somewhat surprising, but it may be related to the old Sangamon River valley.

The Wisconsin drift terminates about 7 or 8 miles west of Decatur which is situated on the inner edge of the Shelbyville moraine. In general, the moraine has a gently undulatory topography with a relief of 75 to 100 feet above the Illinois plain. Deposits of coarse, poorly sorted, poorly rounded gravel with foreset bedding suggesting torrential deposition, are exposed along the valley wall of Sangamon River. In sharp contrast to this is an exposure of a low valley-train terrace of finer, better rounded gravel. This valley train probably belongs either to the Cerro Gordo or to the Champaign moraine to the northeast.

Loess, generally 3 or 4 feet thick and locally fossiliferous where thicker, covers the drift in the Decatur area and is commonly leached down a few inches into the till.

The Wisconsin materials have been altered to a youthful profile of weathering, the Sangamon River has cleared away most of its terrace gravels, and short stubby tributaries of third or fourth order have begun their invasion of the adjacent uplands.

Situated as it is on the terminal moraine of the last ice sheet, and marked by good exposures of different types of glacial deposits and by deposits of older drift sheets and interglacial soils, Decatur affords a splendid opportunity to science teachers for the development of education along sound lines in natural science.

NEW AMERICAN PLANTS FROM THE PENNSYLVANIA PERIOD AS PRESERVED IN COAL BALLS

BY

A. C. NOÉ

University of Chicago and Illinois State Geological Survey

Of the various coal ball localities in Illinois, Indiana, and Texas from which I have made collections, two are almost completely worked up. The first one which has been examined is at Harrisburg, in Saline County in southern Illinois. There, in a now sealed-up mine located in the No. 5 coal seam of Illinois, excellent material was found which has been described by various of my students and friends as well as by myself. The second locality which is also located in an abandoned mine, but in a not yet fully determined, comparatively young coal seam is that of Calhoun in Richland County, Illinois. More than three hundred coal balls from Calhoun have been sectioned and given a preliminary examination. Quite a number of these have been selected for detailed research. During the academic year 1933-34 the following persons besides myself have been occupied with the Calhoun coal balls: Roy Graham, whose doctor's thesis, "Pennsylvanian flora of Illinois as revealed in coal balls, I", appeared in the Botanical Gazette of March, 1934, and Miss Mary Ellen Underwood, whose master's thesis, entitled "Morphology of some Illinois Coal Ball Plants", has been prepared under the supervision of Professor Paul J. Sedgwick in the department of Botany at the Graduate School of Syracuse University. A previous master's dissertation entitled "Morphological Studies of some Illinois Coal Ball Plants" was presented at Syracuse University in the spring of 1933, by Miss W. Louise Crocker.

Our investigations of Calhoun coal balls during the past year have added considerably to our knowledge of the coal ball flora of Illinois. Dr. Graham established in his above mentioned paper six new species and one new genus which had not been known previously, either in America or elsewhere. The new investigations brought to light additional facts about the Cycadofilicales and the Filicales in particular, while the existence of Amyelon radicans, the root of Cordaites, was established for America by Miss Underwood. She also found additional information on the well-known Cycadofilicalis *Heterangium grievii*, and its probable seed Sphaerostoma ovale. Entirely new Cycadofilicales seeds which were described by Roy Graham are *Conostoma platyspermum* and *Conostoma quadratum*. He found also a new microsporangium, *Telangium pygmaeum*, and he established the following new species of fern sporangia: *Notoschizaea robusta*, *Scolecopteris latifolia*, and *Scyathotrachus bulbaceus*. Miss Underwood photographed some excellent cross sections of the petioles of *Botryopteris forensis*. Additional material on Sphenophyllum, Psaronius, and Myeloxylon was found by all of us. One of the coal balls which I examined happened to be cut along the axis of a thick stem of Medullosa showing the branching. There are still quite a number of Calhoun coal balls which need detailed examination. As soon as this is done material from another locality will be studied and gradually our knowledge of the coal ball flora of the Illinois-Indiana-Kentucky basin will give us a fairly complete picture of the vegetation which formed the coal seams of this big basin. Dr. Graham took a number of Calhoun coal balls to Cambridge, England, and studied them in Professor A. C. Seward's laboratory. A paper containing these studies was recently received by the Botanical Gazette.

EFFECTS OF BAROMETRIC PRESSURE AND WINDS ON THE LEVEL OF LAKE MICHIGAN

BY

W. E. POWERS

Northwestern University, Evanston, Illinois

Although most persons know that Lake Michigan fluctuates 3 to 5 feet in level over a period of several years, due to periodic variations in annual precipitation, few are aware of the sharp fluctuations that occur from day to day or even from one hour to the next. Figures 1 and 2 show the hourly levels of Lake Michigan as recorded during February, 1933, at Calumet Harbor, Indiana, and referred to the low-water datum (579.6 ft. A. T.) Two of the larger fluctuations are particularly striking: a rise of 1.93 feet in 41 hours on February 5 to 7, and a rise of 1.22 feet in 4 hours on February 20 to 21, 0.79 feet of this rise occurring during the first hour. During this month the extreme fluctuation was 2.56 feet which occurred within 5 days. The conditions of February, 1933, are quite typical.

The several factors which collectively control the level of Lake Michigan are precipitation, withdrawal of water through the Chicago Sanitary System drainage channel, evaporation, true tides, barometric pressure, winds, and seiches. These controls differ in their relative values.

Precipitation cannot account for the sudden changes in level indicated in figures 1 and 2. No precipitation occurred during the rise of 1.22 feet on February 20 and 21, and only 0.094 feet of precipitation during the rise of 1.93 feet on February 5 to 7.

Withdrawals through the Chicago Sanitary Canal are relatively constant, but differences from day to day should lead to slight changes in lake level. The maximum day-to-day difference during January, 1933, amounted to 1,950 second feet; the depressing effect of this, if spread over the southern half of the Lake Michigan basin would amount to 0.00055 feet, or over the southern quarter of the lake basin, to 0.0011 feet per day. The withdrawals are too small and too slow to account for the fluctuations in level.

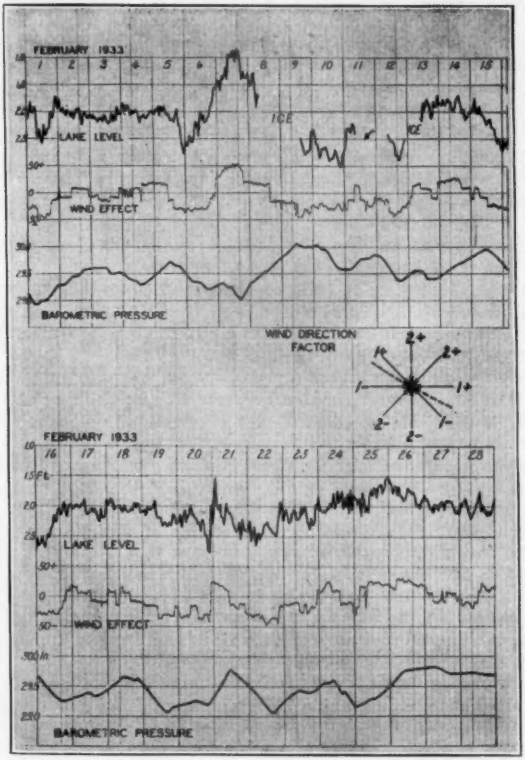
Evaporation from the surface never exceeds 0.021 feet per day, according to Hayford, and therefore evaporation can account for no considerable part of the daily and hourly fluctuations in lake level.

The true tide at Chicago gives a maximum range of oscillation of 0.14 feet. The short period fluctuations (Figs. 1 and 2) are (1) too great to be caused by tides, and (2) do not show the periodicity characteristic of tides.

Barometric pressures should affect the lake level in an inverse relationship. The curve of barometric pressure in figures 1 and 2 shows this inverse relationship on some dates, notably February 7; but it shows a direct relationship at many other times, as on February 1. The "improper" relationships generally occur when the lows and highs pass to the north of Chicago, thus inducing winds that oppose the effects of the barometric pressure.

Wind effects on the lake level during February, 1933, are very marked. Bearing in mind the west-northwesterly trend of the shore at Calumet Harbor and the probable effect of winds in piling up water or repelling it, the writer arbitrarily assigned to the 8 major wind directions the values indicated in the wind rose in figure 2. By multiplying the wind velocities by these wind direction factors the wind effects from hour to hour were computed and plotted in the wind effect curve shown in figures 1 and 2. The close correspondence between this curve and that for the lake levels is marked and indicates that the winds are a major cause of short-period fluctuations.

Seiches are free oscillations of the lake water under the influence of inertia, initiated by changes in distribution of the lake water. The seiches and seiche areas of Lake Michigan have never been carefuly worked out but their importance is unquestioned. Unexplained residuals left after computing the effects of the other factors may represent the effects of the seiches.



—*Courtesy Northwestern University.*

FIGS. 1 (above) and 2 (below). Hourly levels of Lake Michigan at Calumet Harbor, Indiana, during February, 1933, referred to low-water datum. Wind effect computed from records of U. S. Weather Bureau in Chicago. Barometric pressures recorded by microbarograph at Northwestern University.

The surprisingly large short-period fluctuations of the water surface of Lake Michigan correlate best with the wind direction and force, and more poorly with barometric pressure. Precipitation, withdrawals, evaporation and tides individually exert only a very slight control. Seiches are an important factor as yet never accurately evaluated for Lake Michigan.

CLAY-VEINS IN THE SPRINGFIELD (NO. 5) COAL

BY

W. B. ROE

Northwestern University, Evanston, Illinois

As found in the Canton area, the clay-veins in the Springfield (No. 5) coal are made up of clay, shale, sand, or sandstone, in varying degrees of induration, containing isolated masses of coal, roof slate, marine limestone caprock, iron oxide concretions, calcite, pyrite, sphalerite, and galena. The material in the shale or clay type is usually of a light gray color, with a very fine grained texture. Microscopical examination of the clay from the veins shows a predominance of very fine quartz grains and clay flakes, with minor amounts of muscovite.

Veins of the sandy variety closely resemble the typical Pennsylvanian, micaceous sandstones. The material in this type of vein is predominantly a fine to medium grained, yellow to gray sandstone. This variety of vein is much more resistant to weathering than the clay variety and is usually harder in the original unweathered state.

In the clay type, considerable mineralization has occurred in the form of recementation or replacement of a part of the clay by pyrite. Sphalerite and galena occur as well developed crystals, often an inch or so in diameter, but not in disseminated masses. Calcite is more common in the sandy variety, but all unweathered veins are somewhat calcareous.

The veins may intersect the coal bed at any angle, but the more general attitude is at high rather than low ones. They are very irregular in trend, size, and shape. Their thicknesses vary from that of paper to a dozen feet. The walls in many cases show a distant matching, as though they had been torn apart. They are usually more regular in shape and trend in the roof slate or limestone than they are in the coal.

The clay and coal show distinct evidence of movement within the clay mass as well as between the clay and the coal.

The strikes of the clay-veins agree fairly well with the strikes of joints in the roof slate and the limestone caprock, as well as with the strikes of cleats in the No. 5 coal. All of these features, however, vary greatly in strike from place to place, with the varying strike of the rock. This evidence seems to indicate that the clay-veins are of tectonic origin.

The fact that the clay-veins are never observed penetrating through the underclay beneath the coal, and the distinct difference in type of material making up the clay-vein and the underclay point to a place of origin for the material filling the veins either in or above the coal seam. The presence of foreign material, derived from the strata above the coal, in the veins where they cut the coal, indicates that the clay originated above rather than within the coal seam.

THE PORT BYRON LIMESTONE AND ITS FAUNA

BY

T. E. SAVAGE

University of Illinois, Urbana, Illinois

It has long been recognized that a part of the Racine limestone, as developed at Racine, Wisconsin, and in the vicinity of Chicago, Illinois, contains some fossils that are characteristic of the Guelph limestone at Guelph, Ontario, and in New York. However, the coral-reef development of the typical Racine continued without apparent interruption to the end of Racine deposition, and there seems to be no place to divide Racine strata that would separate the part that contains the Guelph species from the part in which these species are absent.

In the northwest part of Illinois there is exposed in a quarry near the village of Port Byron, a Niagaran horizon belonging to a level higher than that of the Racine limestone in the vicinity of Racine or Chicago. During Port Byron time the coral reef conditions appear to have prevailed without a break. Pockets in the reef rock, and on the flanks of the reefs, contain a rich fauna of species other than corals, most of which are not found in the Racine limestone, nor are they known in any other formation except the Le Claire of Iowa.

Among this unique fauna from Port Byron there have been described several new genera and about seventy-five species of cephalopods, and the writer has a dozen or more species of brachiopods and mollusks, none of which occur in the Racine limestone, or in any other member of the Niagaran limestone at any known locality.

This large number of fossil species that seem to be restricted to the Port Byron limestone might be accounted for in two possible ways. It might be assumed that, as this limestone is younger than the Racine, it might originally have been deposited widely over this region, and that it has been removed by erosion over all Illinois except in the vicinity of Port Byron. An alternative explanation might assume that the Port Byron locality was situated in a different marine province from that in which the Racine limestone in the northeast part of the State was deposited.

During Edgewood time the Essex limestone on the east side of the LaSalle anticline, was represented by a similar limestone that occurs at the base of the bluff of Silurian limestone a short distance north of Savanna. The *Stricklandinia pyriformis* zone that, in the vicinity of Savanna, is found about forty feet above the base of the Silurian, occurs at a corresponding horizon on the east side of the anticline near Joliet and St. Charles. The limestone quarried extensively in the river bluff between Port Byron and Fulton, in western Illinois, appears to be the Waukesha limestone.

The above facts make it seem more probable to the writer that the Niagaran limestone in the northeast and the northwest parts of Illinois was deposited in the same marine basin, and that these areas have since been separated by the erosion of the Silurian strata from the top of the anticline in the north-central part of the State.

Neither of the foregoing assumptions explains the source or origin of the Port Byron fauna. It seems certain that it could not have developed from the earlier Racine fauna in this region, for the latter fauna does not contain species from which the Port Byron forms could be expected to have evolved.

Forms ancestral to these species are not known from any other region or provinces of the Niagaran, and the explanation of the source of this fauna must wait a more complete knowledge of the Silurian history.

STRUCTURAL CONTROL OF ORE DEPOSITION IN THE WISCONSIN-ILLINOIS LEAD-ZINC DISTRICT

BY

E. R. SCOTT AND C. H. BEHRE, JR.

Northwestern University, Evanston, Illinois

Recent studies conducted under a grant from Northwestern University have developed certain facts, hitherto inadequately recognized, that bear upon the direction of movement of the ore-depositing solutions in the Wisconsin-Illinois lead-zinc district.

Most earlier workers regarded the "oil rock" as a definite stratigraphic horizon, immediately above the phosphatic bed in the basal Galena dolomite. "Galena" as here used includes the Guttenberg and higher members of Kay. This phosphate horizon and the bentonite five feet below it are apparently dependable key horizons. "Oil rock" resembling that of the Platteville section occurs below both of these key horizons in mines at Dodgeville, Wisconsin. Thus the "oil rock" is a recurrent sedimentary facies, rather than a constant horizon. Its general association with ore is significant.

Superimposed on the southward regional dip are numerous small east-trending basins bearing much of the ore. Drill data, furnished by the Vinegar Hill Zinc Company, and recent detailed mapping shed more light on these basins. Strata immediately beneath the "oil rock" show dips like those of the "oil rock". Smaller basins seen underground exhibit no differential compaction. These facts suggest that even the larger basins are not attributable to unequal compaction of "oil rock", but rather to its deposition on irregular topography, with subsequent accentuation of primary irregularities by tectonic movements.

"Crevices" (vertical ore veins) were restudied. Two pronounced fracture systems trend northeast and northwest respectively, as recognized by earlier geologists. Such a pattern also agrees with the tectonic interpretation of the basins mentioned above.

Faults, though not hitherto reported, were found in the mines. Two general types occur. In the Trewartha mine (west drift), a steeply north-dipping fault strikes northeast. It offsets the bedding and an earlier fault about one foot vertically, and is marked by a conspicuous breccia zone. A more common type of fault, illustrated in the south drift of the Crawford mine, represents compressional fracturing of a bed, with relative shortening along the bedding; the plane is zig-zag in vertical section, crossing the beds, then appearing to continue parallel to the bedding, and higher still crossing the beds again. Examination of faults of this type excludes assigning them to (1) solution of underlying layers and collapse or (2) dominantly horizontal movements on steep fault planes.

The following conclusions may be listed:

1. Contrary to earlier statements the ore does not necessarily occur above shaly "oil rock".
2. Ore is commonest near (in, above, or below) "oil rock": this suggests deposition not through ponding but because of reducing action of bitumens or hydrogen sulphide in the "oil rock".
3. The basins are due to primary irregularities in deposition and subsequent tectonics, yielding the two fissure systems mentioned.
4. There are true faults definitely recognizable, offering channels for passage of ore solutions through shaly horizons. This weakens the argument which, because ores commonly occur above allegedly impervious "oil rock" and shales, assigned ore deposition to decending waters.

OVOVIVIPAROUS REPRODUCTION OF MIOCENE TURRITELLIDAE

BY

A. H. SUTTON

University of Illinois, Urbana, Illinois

ABSTRACT

The discovery of 48, apparently embryonic, shells closely packed in one whorl of a large specimen of *Turritella alumensis* Mansfield from the Choctawhatchee (Miocene) formation at Alum Bluff, Florida, increases our knowledge of reproduction in this genus. Thirty five years ago Frank Burns[1] reported the occurrence of embryonic shells in specimens of *Turritella cumberlandia* Conrad and *T. indenta* Conrad from the Miocene beds at Plum Point, Maryland. Not enough information on the reproductive habits of *Turritellidae* was available at that time to allow comparison of fossil with modern forms. Recently Dr. Marie V. Lebour[2] has reported on the eggs and larvae of *Turritella communis* Lamarck, a living oviparous species.

The 48 small shells are all essentially the same in size and stage of development. Each is approximately 2.5 mm. in length, from 1.6 to 1.75 mm. in maximum width and consists of the protoconch and three spiral whorls. There are no signs of abrasion on the shells, each preserving the spiral shell sculpture of the species.

There are four possible explanations of the occurrence of the small shells in the large individual: (1) they may have hatched from eggs deposited in the large shell after death of the large individual, (2) they may be the remains of young which of their own accord crawled into the large shell after death of the large individual and there perished, (3) they might have been washed into the large shell after death of all forms or, (4) they may represent unborn young.

The position of the small forms in the large shell, the similar size and stage of development of all the small shells, their unworn character, and the absence of this species or others of similar size in any other portion of the large shell or in the sediment surrounding, adhering to, or filling other shells of the collection seem to eliminate from consideration all of the hypotheses of origin except the last.

The conclusions reached as a result of the study are: (1) these shells are embryonic, the mother having died before birth of the young and, as the body decayed, fine sediment filled the large shell preventing any wear or destruction of the small forms, and (2) *Turritella* during its evolution from the Miocene to the present either has undergone important modification of the reproductive method, the development of an oviparous from an ovoviviparous habit, or the fossil Miocene forms, called *Turritella*, were not as closely related to living species of *Turritella* as formerly has been supposed.

---

[1] Burns, Frank, Viviparous Miocene Turritellidae. The Nautilus Vol. XIII, No. 6, pp. 68-69, October 1899.

[2] Lebour, Marie V., The Eggs and Larvae of *Turritella communis* Lamarck and *Aporrhais pes-pelicani* (L). Journal of the Marine Biological Association of the United Kingdom, Vol. XVIII, No. 2, pp. 499-506, Jan. 1933.

THE INTEGRATION OF SCIENCES REQUIRED FOR A LOGICAL STUDY OF COAL

BY

GILBERT THIESSEN

State Geological Survey, Urbana, Illinois

Because coal is a heterogeneous mixture of chemical compounds formed from botanical structures by biological means, the whole metamorphosed by physical forces exerted by geological processes, a study of coal requires the application of all of the natural sciences.

The fact that in spite of the vast literature on the subject, we know relatively little about the fundamental properties of coal is caused by the fact that the data contained in this literature represent mainly the viewpoint of only the particular science used by the investigator, or, indeed frequently the viewpoint of only a very specialized part of that science. Among others, the sciences of geology, petrology, paleontology, botany, chemistry, bacteriology, and physics are concerned in the study of coal. Findings of each science must be critically reviewed in the light of other sciences. Failure to do this has often led to erroneous conclusions. For example, certain chemical work has been put forth in Germany, purporting to show that cellulose rather than lignin is the substance from which coal originates. The argument is that coals artificially produced from lignin show cell structure, while those from cellulose do not; natural coals showing no cell structure in the woody tissue are therefore derived from cellulose. This argument entirely rejects the findings of biologists who have shown that the cellulose in wood is readily destroyed by decay while lignin is stable; of peat investigators, who have shown that cellulose is exceedingly rare in the lower parts of peat swamps, and that cellulose content decreases with age of the peat; and of microscopists, who have shown conclusively that coal derived from woody tissues always shows structure, though in some cases very refined technique is required to demonstrate it.

The geologist has, at times, tried to estimate the temperatures to which coal deposits were subjected during metamorphosis. Their estimates are frequently in the neighborhood of 200° to 300°C. as a maximum. If the conclusions of Lipman that bacteria have continued to live in coal since the peat stage are true, then this temperature must be revised downwards. The geologists in this phase of the work must cooperate thoroughly with the bacteriologist, but at the same time must be very critical of his work. The geologist, the bacteriologist, and the pedologist have related interests. Some chemists in studying coal have frequently been too prone to treat coal as a homogeneous material—as a pure compound whose identity is to be unraveled. A casual consideration of the compounds making up the plants whose decay products form coal, let alone a microscopic examination of coal, can leave no doubt as to the heterogeneous nature of coal. A study of the compounds in plants and the changes which these compounds undergo during decay and in the early stages of coalification, promises much greater progress in unravelling the chemical nature of coal than does the study of coal itself. To do this, however, the chemist must familiarize himself with the chemistry of living plants, with plant anatomy, with decay and the biology of decay organisms, and with the geology of coal formation. All of his conclusions must stand scrutiny in the light of the findings of other sciences as to the conditions under which the chemical changes took place.

If we study the minerals in coal, we bring mineralogy into the picture. It would seem that this should have been done long ago, yet a review of the literature shows that no mineralogical study of coal with any degree of completeness or accuracy has been made until the last two years. Other studies are found to be speculations based upon ash analyses and minerals found in nature. True, the minerals are found in nature, but only a certain few are found to make up over 95 per cent of the mineral matter in coal. A small amount of scientific study can settle volumes of philosophical speculation. Because of these accurately made mineralogical studies, we can take a new hold on the problem of ash-to-mineral matter calculations. By studying the fracture planes in coal, the physicist can tell to what forces the coal was subjected and perhaps their relative magnitude. Since the geologist believes that earth and tectonic pressures have much to do with coalification, the relationship is obvious. The behavior of coal components under high pressures is of great importance from the standpoint of possible flow of components from one part of the coal structure to another. For example, whether the resinous material to be found in fusain was always there, or whether it flowed in after fusainization is an important question in deciding the origin of fusain.

BOUNDARIES OF PENNSYLVANIAN CYCLOTHEMS[1]

BY

J. MARVIN WELLER

Illinois State Geological Survey, Urbana, Illinois

Many geologists believe that the top of the coal bed or the base of the marine members, if coal be absent, should constitute the boundary between cyclothems. Some favor the base of the coal. The writer contends that the base of the sandstone is the most logical boundary. Three other suggested horizons are believed to be unimportant and are not considered here.

It is generally agreed that diastrophism offers the best means for the major subdivision of geologic time and it is only logical that it be employed in minor subdivision if possible. Diastrophism is preeminently suggested at two horizons in the cyclothem: (1) at the top of the coal when the basin sank beneath the sea, and (2) at the base of the sandstone when the basin was elevated. The base of the coal does not clearly record a diastrophic movement and if the importance of diastrophism be admitted the unsuitability of this horizon as a boundary must be recognized.

According to the original conception, sedimentary cycles consist of beds deposited during a single incursion of the sea, separated by unconformities that represent periods of emergence. With the introduction of nonmarine beds in alternation with marine sediments the question arises, should these be included with the under or overlying marine cycle. By choosing the top of the coal as the boundary the nonmarine beds are included with the preceding marine cycle for which there appears to be no specific reason except local convenience.

In a basin of deposition, subsidence must be dominant. The particular subsidence that allowed submergence conforms to this general movement and is not necessarily unique. Uplift in the basin, however, would constitute a conspicuous irregularity, promptly recorded by change in sedimentation and perhaps by unconformity, and would furnish a more significant basis for cyclical differentiation.

Most important cycles of erosion have probably influenced sedimentation in adjoining basins so strongly that corresponding sedimentary cycles have been produced. Erosion and deposition are phases of a single physiographic process and the cycles of erosion and deposition should be defined with corresponding limits. Cycles of erosion are initiated by uplift and the early sediments produced are the coarsest. Therefore, the cycle of deposition should also be initiated by uplift, if uplift of the basin occurred, and the coarsest sediments should be considered the basal deposit.

The base of the sandstone is the logical boundary between cyclothems because (1) uplift of the basin is most strongly suggested, and unconformity most conspicuous at this horizon, and (2) the cycle of sedimentation is made to correspond with a possible related cycle of erosion. A boundary corresponding to the top of the coal can be recognized only where a coal horizon is present or marine beds overlie other types of nonmarine strata. The horizon corresponding to the base of the sandstone, however, can probably be recognized by change in sediment far beyond the limits of these members and is, therefore, probably of much wider application. Consequently this boundary is superior practically as well as theoretically.

[1] Published by permission of the Chief, Illinois State Geological Survey.

THE SUBSURFACE STRATIGRAPHY OF THE DECATUR REGION

BY

L. E. WORKMAN

State Geological Survey, Urbana, Illinois

Decatur is situated above probably the deepest part of the syncline west of the LaSalle Anticline. Although no wells have reached the St. Peter sandstone in the immediate vicinity, it is estimated on good data that the top of that formation lies at a depth of about 3,100 feet. On less reliable data it is further estimated that at least an additional 3,100 feet of sedimentary rocks underlie this to a total depth of 6,200 feet to the pre-Cambrian granite. The sediments below the St. Peter consist in the lower half of coarse sandstone, and in the upper mostly of dolomites, but with some shale and sandstone formations. They represent all of the Upper Cambrian and the Prairie du Chien series of the lower Ordovician period.

The St. Peter sandstone is well known for its clean, white, medium grained sand. Above the St. Peter are the Platteville, Decorah, and Galena limestone formations in the order given, a total thickness of about 500 feet. The first is a mottled brown and gray, very fine grained limestone or dolomite, the second a shaly limestone, and the third a light brown coarsely crystalline limestone or dolomite. It is in this general region of Decatur that these formations change from being dominantly dolomite to the north and dominantly limestone to the south. The Maquoketa shale formation completes the Ordovician succession. It consists of a lower third of brown shale, a middle third of coarse grained limestone with interbedded brown and gray shale, and an upper third of green shale with limestone lenses.

The Silurian formations are similar to the St. Genevieve section of southeastern Missouri rather than to the Chicago section, having the brown cherty Edgewood limestone at the base, the pink, green and white speckled limestone of the Brassfield above, and red, gray and greenish, shaly dolomitic limestones similar to the Bainbridge above that. Studies of the Silurian in the region of Tuscola and southeastward into the oil fields show that at least 200 feet of Silurian is absent from the upper part of the section in the Decatur region where the total thickness is about 450 feet.

The Devonian system varies from 7 to 57 feet in thickness in sets of samples from the Decatur region. The brownish sandy and lithographic limestone with associated dolomite suggest the Wapsipinicon and Cedar Valley formations of the Rock Island region. There is much dense gray chert in the rocks which is distinctly different from the chert of the underlying Silurian beds.

The Sweetland Creek brown, Sporangites shale is 150 feet thick and has at its base a thin sandstone made up of reworked sand grains from the Devonian limestone. The upper layers of shale grade to black and dark gray. The question of the Devonian and Mississippian classification of the Sweetland Creek formation has been much discussed.

Of the Mississippian formations the Fern Glen red and green shales and cherty limestones are near the base, being about 100 feet thick. They are regarded as Osage and are followed in the same series by 140 feet of typical, very cherty, white to light gray Burlington and Keokuk limestones. East of the LaSalle anticline the Osage consists of sandy shales and sandstones quite unlike these formations. The Warsaw formation consists of a lower half of dark silty shale, and an upper half of shaly sandstones, sandy limestones, and sandy shales. The total thickness increases from 100 feet near St. Louis

to 300 feet at Decatur. A limestone less than 30 feet thick and typical of the granular Endothyra-bearing Salem lies on top of the Warsaw sandstone. The St. Louis limestone is 100 to 200 feet thick at Decatur. It has suffered an erosion of 100 or more feet previous to the deposition of the Chester series.

The Chester series is represented by the Aux Vases, Renault, Yankeetown, Paint Creek, Cypress, and lowest beds of the Golconda formations, having a total thickness of 300 feet.

The Pennsylvanian sediments, 800 feet thick, consist mostly of shales and limestones. There are some sandstones and coals. The coal mined at Decatur is known as the No. 5 seam, reached at a depth of 560 feet in the shaft in the southern part of the city and 650 feet in the oil-test wells northwest of the city. A prominent red bed is encountered at about 350 feet and the Shoal Creek limestone at about 200 feet in these wells.

The bedrock in Macon County is everywhere covered by 100 to 200 feet of glacial drift.

THE SUBSURFACE STRATIGRAPHY OF THE DEVONIAN IN WESTERN ILLINOIS

BY

L. E. WORKMAN

Illinois State Geological Survey

AND

J. HUNER, JR.

University of Illinois, Urbana, Illinois

In the study of sample well cuttings and their residues from solution in acid, the Devonian strata in Adams, Hancock and McDonough counties is found to have the same divisions as in the Davenport and Rock Island regions. The Wapsipinicon limestone is at the base and the Cedar Valley above.

The Wapsipinicon is further sub-divided in the region studied into the Otis at the base—a very fine grained somewhat sandy, fossiliferous, slightly dolomitic limestone; the Independence shale above—a weak, plastic, massive, calcareous shale; and the Davenport at the top and occupying the greater part of the Wapsipinicon formation—a clean, hard, lithographic limestone which is slightly sandy near the top.

In the Cedar Valley limestone five distinct horizons were recognized: (1) a basal, fossiliferous, slightly dolomitic limestone, very sandy at the bottom and slightly cherty throughout. The lower sandy zone grades to a true sandstone with fine to medium rounded grains which is the Hoing sand; (2) A very cherty, fossiliferous, slightly dolomitic limestone differing from the basal horizon in containing only a trace of sand. Since this is recognizable only near Warsaw and in the northern part of Adams County, it may be of only local occurrence; (3) An argillaceous, dolomitic limestone containing dark gray, calcareous fossils such as Tentaculites, ostracods, and brachiopod fragments. This horizon is a typical development of the Cedar Valley as described from the Rock Island region; (4) A very cherty, slightly dolomitic, fossiliferous limestone containing some sand; (5) A somewhat

variable limestone which is sandy at the base and grades upward to a slightly cherty, lithographic limestone near the top.

In most of Adams and Hancock counties the complete Devonian succession is found but over the Colmar-Plymouth dome in southwestern McDonough County only the basal Cedar Valley is present, the Wapsipinicon having been eroded away before Cedar Valley time. Southwestward from the Colmar-Plymouth dome the Devonian thins rapidly to and disappears entirely in a small area in the southeast corner of Hancock County. It reappears to the west and in the north-central part of Adams County the maximum thickness of 170 feet for the area studied is reached. Northwestward in Iowa a single set of cuttings from the Mt. Pleasant well shows a thickness of 247 feet and southwestward another set in Shelby County, Missouri, shows 182 feet. The increase of the Devonian thickness is mostly in the Cedar Valley for the Wapsipinicon is generally constant in thickness.

The Hoing sandstone at or in the base of the Cedar Valley limestone is similar in character to the Devonian Beauvais sandstone of southeastern Missouri. There it lies directly below the St. Laurent limestone which is correlated by Branson[1] with the Callaway in northeastern Missouri and the Cedar Valley of Iowa. It therefore appears that the Hoing sand is the northern extension of the Beauvais sandstone.

The Devonian system lies unconformably on the eroded edges of older strata. At the Colmar-Plymouth dome it is underlain by the basal Maquoketa shale. Westward it rests on the Kimmswick, except for a few remnants of the Maquoketa, and the two sets of cuttings from northeastern Missouri and southeastern Iowa indicate that the same is true west of the Mississippi River. In the Rock Island region[2] outcrop studies indicate a slight erosional unconformity between the Wapsipinicon and the Cedar Valley. This is emphasized on the Colmar-Plymouth dome. Sample well cuttings in certain places show a dark brown to brownish gray, finely laminated shale at this horizon. The Cedar Valley is overlain unconformably by the Sweetland Creek shale which everywhere contains a thin basal pyritic sandstone composed of reworked Devonian sand grains.

[1] Branson, E. B., Devonian of Missouri, Missouri Bureau of Geology and Mines, Volume XVII, 2nd Series, 1923, page 2.
[2] Ekblaw, G. E., unpublished report, Illinois State Geological Survey, 1930.

PAPERS IN PHYSICS

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Six of the seven papers that comprised the Physics program were given at the section meeting; all six were presented for publication.

Attendance at the meeting averaged seventy, maximum attendance was seventy-five.

Dr. Lester I. Bockstahler, Northwestern University, Evanston, Illinois, was elected chairman for 1934-35.

(Signed) JAKOB KUNZ, *Chairman*

A COMPACT VACUUM GAUGE FOR MEASURING PRESSURES RANGING FROM .2 MM DOWN TO .0001 MM OF MERCURY

BY

CHAS. T. KNIPP

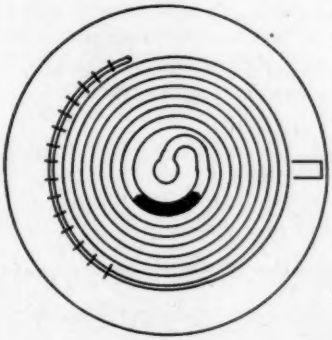
University of Illinois, Urbana, Illinois

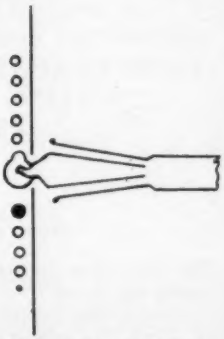
Vacuum gauges are necessary equipment in a modern vacuum laboratory. This equipment is made necessary by the ever increasing use of vacuum devices, not only in research and in the industries, but also in the home. The perfection of the mercury vapor vacuum pump is also an important factor.

Vacuum gauges measure the pressure within an evacuated system in terms of mm of mercury. There are numerous types. Some are absolute in that their readings are deducible directly from a knowledge of Boyle's law, and others must be calibrated by reference to a known standard. The most commonly used of the former type is the well known McLeod gauge. This is the only one that will be referred to in this brief note.

The McLeod gauge (when constructed for the measurement of very high vacua) requires about 20 pounds of mercury for its operation. This in itself is quite an item of expense.

The principle of this gauge is that a known volume of air (say 1 liter) is compressed into an exceedingly small volume of a few cubic millimeters and the corresponding pressure required to do this is read. From the two volumes and the pressure the actual pressure of the gas in the evacuated system is deduced in mm of mercury as previously stated. This gauge not only requires much mercury but is ungainly in shape, heavy to handle, and easily broken.





—Courtesy University of Illinois.

FIG. 1 (Left).—Front elevation

FIG. 2 (Right).—Side elevation.

A suggestion for a modified form of McLeod gauge is as follows: This takes the form of a flat spiral of glass tubing of about 1 cm internal diameter. A front elevation is shown in Fig. 1 and a side elevation in Fig. 2. The outer end of the spiral for about one-half turn is drawn out in a decreasing

diametered capillary as shown in Fig. 1. The spiral at the center terminates in a bulb which in turn is fused to an axial tube at right angles to the plane of the spiral.

This axis (and with it the spiral) turns in the ground joint shown in Fig. 2. This gauge requires but 8 to 10 cu. cm of mercury for its operation. The mercury, to begin with, is placed in the central bulb. This gauge must be calibrated. When in use the gauge is fused to the system with the ground joint horizontal. The spiral is then turned until the mercury all runs into the central bulb. In this position the vacuum connection between the spiral and the rest of the system is open. The system is now pumped out to any degree of exhaustion desired. To read the gauge it is only necessary to turn the spiral counter-clockwise (facing Fig. 1). The mercury as the turning proceeds will drop into the spiral as shown in the figure and travel along it forcing the trapped gas ahead of it ultimately compressing it in the capillary end of the spiral. The slug of mercury becomes longer as it reaches the narrower portion of the spiral and finally the reading is given when the right hand end is brought even with the stop (shown to right), and the left end to some point on the graduated scale. A calibration curve gives the pressure in mm of mercury.

Having taken the reading the spiral is now turned in the opposite direction (clockwise) depositing the mercury again in the center. Considerable care must be taken in the operation of the gauge since it too is made of glass. If the mercury is always returned to the central bulb *before* opening the stopcocks, or starting the pump, all will go well. Another manipulation difficulty may be with the ground joint. To prevent this from running dry it should be made long, very long (3 inches), and truly ground. This gauge is compact, requires but little mercury, and will give good service in the hands of a careful worker. Its range is from about .2 mm down to .0001 mm of mercury.

RENEWED ACTIVITY OF RADIUM BROMIDE AFTER HEATING, AS REVEALED IN A WILSON EXPANSION CHAMBER

BY

CHAS. T. KNIPP

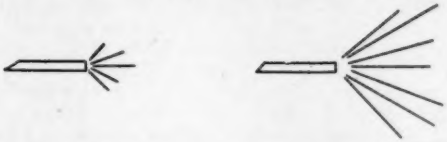
University of Illinois, Urbana, Illinois

The recovery of the activity of a radioactive substance may be studied by proceeding as follows:

Place a minute quantity of the radioactive salt on the end of a solid rod (about 2 mm in diameter) of Pyrex glass by wetting the tip with alcohol containing a little shellac. Next blow a thin-walled bulb of Pyrex glass so thin that it *shows* Newton's rings in the form of *broad colored bands*. Now hold the tip in a soft blast, heating it slightly from the rear to insure against loss of radioactive material by the action of the blast, and when the tip begins to soften and assumes a spherical form, and with the thin walled bulb in line and in readiness, plunge the tip into it. This operation will cover the heated end of the tip with a thin film of glass, thus sealing in the radioactive salt. The tip may now be used in a Wilson expansion chamber without fear of losing any of the active material, and should last indefinitely as a source of alpha-particles free from emanation. This latter, obviously, is

not able to pass through the thin glass film. Tips thus prepared were made over ten years ago by the writer and the protective film of glass seems to be intact.

If a *freshly* prepared tip is placed in a Wilson expansion chamber and the proper expansion is brought about, tracks will appear, but they will be few in number and only about one cm in length, as shown in Fig. 1. Re-



FIGS. 1 and 2.—Renewed activity of radium bromide. *(Courtesy University of Illinois.)*

peated expansions *immediately* following this one will not increase the number or length of the tracks. This apparently poor showing is disconcerting, for one naturally concludes that the tip is a poor one—that it contains but little active material under its film of glass, or that possibly the film is too thick. However if the apparatus be let stand for a day, the tracks will become more numerous and their lengths increase. This will come as a surprise. This increase in number and length has further support as time goes on. After ten days the alpha-ray tracks will seemingly have reached their full length—about 7 cm—and the number may vary from 20 to 40. The sketches shown in Figs. 1 and 2 are drawn to represent the first and last stages in this recovery of activity process. The explanation at first may seem a bit puzzling. It is quite evident that at the beginning when the salt is red hot, there is little or no activity trapped under the film of glass, but with time, this, also the emanation, builds up and reaches the steady state. This requires as stated above from six to ten days. The phenomenon is interesting and very pronounced.

MODEL OF AN ELECTRIC CELL, SIMULATING ION AND ELECTRON FLOW

BY

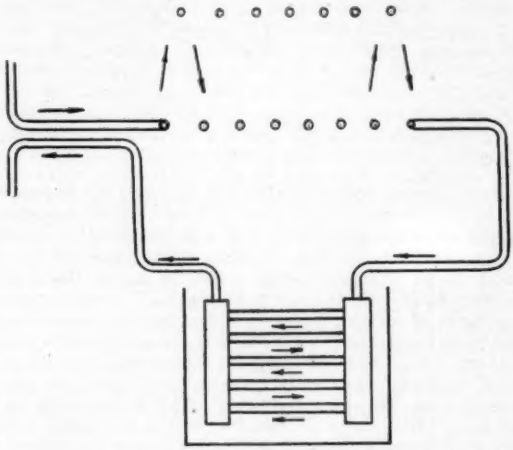
CHAS. T. KNIPP

University of Illinois, Urbana, Illinois

During the spring of 1934 a model of ion and electron flow in an electric cell was constructed in the physics laboratory. It was tried as an experiment at first and exhibited at the bi-annual Electric Engineering show held at the university in April and worked so well that it was planned to set it up at the "Century of Progress" fair, Chicago, for the summer.

The model in outline is shown in Fig. 1. All the parts are of Pyrex glass tubing of about 1 cm internal diameter. Beginning with the arrow at the upper left-hand corner of the figure and following round one comes first to the glass solenoid. This is 8 inches in diameter and about 12 inches long and has 10 turns. From this solenoid the tube leads to the battery cell and

disappears in the positive electrode (a hollow copper box) and after traversing back and forth between this and the negative electrode (a similar box of zinc) it emerges and completes the circuit by passing up to near the starting point. To make the battery more realistic the improvised electrodes with their connecting tubes are placed in a large battery jar filled with water to the usual height. A few copper sulfate crystals placed in the jar adds color to the liquid in case one wishes to simulate a blue cell.



—Courtesy University of Illinois.

FIG. 1.—Model of an electric cell.

The operation of the model is quite simple, yet it requires considerable care in making the initial adjustments. It is only necessary to allow a stream of water from a suitable head (not shown in the figure) to flow down through the solenoid and on down through the cell (back and forth a number of times) and then on up to the starting point, as shown in Fig. 1 where it turns down and flows into the sink. The flow of electrons and ions is simulated by introducing air bubbles closely spaced at a point near the head. These are carried along by the flowing water, through the solenoid and down to the positive electrode of the battery. To this point the bubbles represent electrons (of course flowing against the conventional current). Their flow back and forth in the cell between the electrodes represents ions (plus ions and minus ions), while they again represent electrons as they leave the negative electrode (zinc) and complete the circuit.

To make the illusion more complete the incoming tube should be placed in front of the outgoing tube, thus making the flow appear to be continuous round the battery circuit.

The portion of the apparatus to the left at this point is screened from view.

In the Chicago set-up the same liquid was used over and over by the use of a small motor driven pump. The water should be slightly colored.

ELECTRON DIFFRACTION AND THE PHYSICS OF SOLIDS

BY

LESTER I. BOCKSTAHLER

Department of Physics, Northwestern University, Evanston, Illinois

During the last ten years our knowledge of the structure and properties of matter has greatly increased. One notes, however, that a large part of this information has to do with the gaseous or vapor state of matter. Studies of the solid state have lagged somewhat or at least have not been so amenable to interpretation in terms of forces and energy of the primary building units, whatever they may be. The introduction of X-ray analysis some twenty years ago resulted in a very complete knowledge of the arrangement of crystals and atoms in solids. The relation of many of the physical properties of a solid to its structure is not so well known.

The discovery that electrons are diffracted or selectively reflected by atoms in a crystal lattice has created a new tool for the study of the latter problem. Much of the theory developed for X-ray analysis can be carried over in electron diffraction studies. There are, however, certain advantages in each method. X-rays will penetrate a considerable thickness of a solid. Electron experiments must be confined to surface layers or thin films of the substance. The amplitude of the wavelets accompanying the electrons scattered by few atoms is so strong that diffraction effects can be obtained from exceedingly thin layers of material. In certain organic substances electron experiments yield patterns due to the carbon atoms in the molecule whereas the X-ray pattern is largely due to the molecular aggregate.

It is not my purpose to compare or contrast these two excellent aids in the study of solids. I wish to point out certain results which have been obtained and call attention to some problems yet to be tested by electron diffraction. In the recent theories of metals the question as to the number and energy of the free electrons arises. One is able, by means of diffraction experiments, to determine this energy commonly called the "inner potential".

The next field is in the inyestigation of orientations of crystal planes in thin films. This is of importance in photo electric work, in the transmission and reflection of light, in the resistance to oxidation or gas adsorption, polishing of surfaces, in short, any property which is specifically concerned with the surface of the solid.

It has been found that forming films by evaporation at certain temperatures will result in the selective orientation of crystal planes with respect to the backing surface. Silver on molybdenum deposited at 650° C prefers the 111 orientation while at 700° C there is little preference. Silvered optical mirrors when treated with aqua regia become better reflectors, and prefer to have the 110 plane of the oxide parallel to the surface.

The surface of a highly polished metal is revealed as a layer of molecular aggregates not unlike a super cooled liquid.

Questions having to do with curious and varying photo electric effects are no doubt related to the structure of the surface of the emitter. Different gases and varying pressures alter the structure of the surface of film deposited by sputtering or evaporation. The diffraction or reflection of electrons from such surfaces should throw some light on the processes involved. An examination of the rate of change of a collodial layer of a solid to a crystalline layer must in the end bear some relation to the forces existing in a solid. The catalytic action of such substances as platinum on asbestos is no doubt associated with the surface conditions.

In increasing our knowledge of the physics of solids it seems desirable to begin with the simple structures first. It is not likely that a structure more simple than the thin film and crystal is to be found in the solid state. For such studies electron diffraction methods are unusually adequate.

THE FLOW OF LIQUIDS THROUGH SUBMERGED ORIFICES

BY

JAKOB KUNZ

University of Illinois, Urbana, Illinois

The loss of head Δ h in a liquid, when flowing through a submerged orifice, has been measured by F. E. Giesecke. From his measurements two definite laws have been deduced: the loss of head or pressure difference is proportional to the square of the velocity; a fact which follows immediately from the principle of dimensional homogeneity; and in the second place the loss is an exponential function of the diameter D of the circular tube, Δ h being proportional to e^{-aD} where $a = 3.32$ and D is the diameter.

If the diaphragm is completely closed, the pressure will increase and a pressure wave will travel through the liquid column with the velocity of sound, but there is also another phenomenon recently observed by E. E. Ambrosius and J. C. Reed, namely the liquid returns at the diaphragm and moves along the wall of the tube in a direction opposite to the original motion in the center. If R is the radius of the tube and r the radius of the central veine, which flows in the original direction, then for laminar motion $r = R \cdot 0.71$, while for turbulent motion $r = R \cdot 0.766$. In the case of laminar motion it is shown that the velocity gradually dies down after the closing of the diaphragm according to the law: $\mu^2 = u_0^2 e^{-\frac{16\mu t}{\rho R^2}}$, where u is the average velocity within the veine of radius R, μ the viscosity, ρ the density and t the time, and u_0 a constant velocity. This expression and $r = R \cdot 0.71$ have already been verified by measurements of Ambrosius and Reed. When the diaphragm is suddenly closed, there is a pressure increase $p = um\sqrt{v_s}$, where m is the mass per unit volume, u the average velocity, V_s the velocity of sound in the liquid column; this pressure increase is the same when the liquid turns around and moves backward. This backward motion, obeying at first the exponential law, is unstable and soon breaks up in irregular turbulent motion.

From the submerged orifice there issues a jet, which seems to move in a sinus-oidal form, being accompanied by a system of vortices which finally in some distance from the orifice break up into turbulent motion. The system of vortices reminds me somewhat of the vortex ally of von Karman. But there may be vortex rings, whose axes are inclined toward the direction of the general motion. Or the issuing jet may describe a spiral motion. Indeed experiments have been made with a jet of smoke from a turpentine flame, which showed, from time to time, beautiful spiral motions of the form of a twisted elastic ribbon.

THE PRESENT CRISIS IN THEORETICAL PHYSICS

BY

JAKOB KUNZ

University of Illinois, Urbana, Illinois

We are living in a period of great physical discoveries, which follow each other in rapid succession. After the discovery of radioactivity, the electron, and Roentgen rays, toward the end of the last century, there followed the discovery of the diffraction of Roentgen rays, the Stern-Gerlach experiment, the Compton and Raman effects, the diffraction of electrons and hydrogen atoms, the discoveries of heavy hydrogen, of positrons, neutrons, induced radioactivity and the transmutation of the chemical elements.

This rapid progress in experimental physics is accompanied by a bold speculation in theoretical physics, aiming to coordinate all the wonderful phenomena discovered in experimental physics. The present mathematical researches in theoretical physics are dominated by two theories, the theory of relativity and the quantum theory. The special and the general theory of relativity rest on definite principles from which very definite conclusions can be drawn and which are in agreement with experiments. But unfortunately the logically perfect special theory of relativity, abandoning the ether as seat of the electromagnetic phenomena, becomes a purely mathematical-analytical theory rejecting all intuitive understanding of physical phenomena without mathematical formulae. It does not give a physical world picture, but only a formula. The mathematical apparatus of the general theory of relativity is much more complicated than that of the special relativity, and it coordinates besides the phenomena of Newtonian mechanics as a special case, three microscopic phenomena. The world appears as a four dimensional non-Euclidean, nonuniform finite continuum. While it is mathematically easy to construct such worlds, the space-time continuum of Minkowski and of general relativity are for me purely formal mathematical expressions or constructions. I do not live and make experiences in a non-Euclidean world of four dimensions. A four or two dimensional being is for me only a mathematical abstraction without contact with sense experience.

The quantum theory.—In the 18th century light was considered as made up of particles; in the 19th century as a wave in a medium called ether; and now since 1900 after Planck's ideas of radiation either as a wave or as particles called photons, or quanta of energy $E = h\nu$, which are emitted or absorbed in a discontinuous process, ruled by statistics. In 1905 Einstein materialized this idea concerning light to consist of particles of energy $h\nu$. In the photoelectric effect this energy is transformed into kinetic energy of moving electrons. The Compton effect also consists in a transformation of light energy of Roentgen rays into kinetic energy of electrons. But here an individual elementary collision between a photon and an electron is assumed with conservation of energy and of momentum. If the momentum is equal to $E/c = mc = h\nu/c = h/\lambda$, and if we assume for the momentum of an electron $g = mv = h/\lambda$, then $\lambda = h/mv$; i. e., the relation of deBroglie, i. e., with a moving particle is associated a wave of wavelength λ. But before the discovery of the Compton effect and the diffraction of electrons N, Bohr had made great progress in the theory of the structure of the atom, giving a rational explanation of the Balmer, Lyman and Paschen series of the hydrogen atom. This theory of Bohr was extended by Somerfeld, who introduced relativity into Bohr's theory. The theory was successful in many respects and gave rise to a classification of the line spectra by means of

quantum numbers. But the theory was unable to explain the spectrum of helium, the next simple element after hydrogen. This theory was replaced by wave mechanics, quantum mechanics or probability mechanics, whose principles are difficult to enumerate separately, but which is largely based on Schrödinger's wave equation and the uncertainty principle. According to this principle it is impossible to measure in one experiment alone both the position and the momentum of one electron. If we determine the position, then we alter the momentum and vice-versa. Knowledge of position and velocity of a subatomic system is not obtainable, scientific causality breaks down, the future remains uncertain and open. We can determine only the probability of an atomic event, not the event itself. But if in the laboratory we look at the experiments on atomic structure, for instance the line spectra of the elements, they are just as well or better defined as other phenomena treated in classical physics. Hence either scientific causality has to be given up altogether, or it rules the atomic phenomena as well as the microscopic phenomena. The uncertainty may be only a subjective indeterminancy. Compton's experiments may be explained in different ways. That even in bulk experiments we disturb the quantities to be measured by means of our measuring instruments, is often a bitter experience of the experimental physicist. In the Schrödinger equation we have to know the kinetic and potential energy of the atomic or molecular system simultaneously, i.e., position and velocity, and here we introduce classical values. Herein I see a violation of the uncertainty principle itself. The question arises, if there are waves of electrons, what is the wave made of? It seems to me that the wave is taken in two different senses; a wave of an electron is considered either as a material wave (—for diffraction) or as probability wave (—in atomic structure.) The Schrödinger function for an atom with two electrons represents a wave in a six-dimensional space, for an atom with three electrons a wave in a nine-dimensions, in an atom with 92 electrons a wave in $92 \cdot 3 = 276$ dimensions! I doubt if any theoretical physicist believes in these dimensions in atomic systems, i. e., the Schrödinger equation again is a purely formal mathematical construction. Efforts to imagine such spaces, must forever fail. There are other difficulties connected with this function which I must omit here. Difficulties arise also with the mass and size of the photon. In the photoelectric and Compton effect, the photon is considered as of very small size, but in the formation of the image of a star, whose light is reflected from a 100-inch reflector, the photon must be of the size of the reflector. Moreover the energy E of a photon is equal to $h\nu$, its mass $m = h\nu/c^2$. But according to relativity the mass of a particle depends on the velocity v

$$m = \frac{m_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

and if $v = c$, then the mass becomes infinite. To assume the rest mass m_o equal to zero, destroys the conception of mass, as an empirical quantity altogether. Finally, if light from a source is emitted as particles, how can the velocity of light be independent of the velocity of the source, an assumption which is fundamental in special relativity. Both the wave theory and the corpuscular theory of light are true, but both together cannot be true.

NOTES ON THE FOUCAULT PENDULUM

BY

K. G. LARSON

Augustana College, Rock Island, Illinois

A pendulum weighing 33.1 kg., and 661 cm. long has been hung in the tower of the Old Main, on our campus. The suspension is of the double roller and steel plate type, described by A. C. Longden (Phys. Rev. 13:241, April 1919).

A steel roller 1.429 cm. diameter and 9 cm. long is mounted in a V-groove, on a steel rail fixed securely in an east-west line to the floor in an upper room. A steel plate 1.2 cm. thick[1] and 9 cm. square rests on it. A second roller in a north-south line on top of the plate supports a stirrup having a V-groove in its instep. The side members of this stirrup, 45 cm. long, extend down through the floor to the room below. A soft iron wire .072 cm. diameter forms a bifilar suspension for the ball from the stirrup.

The counterpoise, which is necessary to increase the moment of inertia of the shorter north-south component of the pendulum, consists of two 3.5 kg. weights, one at either end of a steel rod 1.59 cm. diameter and 98 cm. long, clamped to the plate in a north-south direction, horizontal. This construction and the length of the legs of the stirrup are intended to avoid the top-heavy rocking of the plate, which it was feared would occur due to the action of gravity on a counterpoise supported vertically above the plate.

The reflection of an index at the bottom of the ball in a mirror below, and very close to it, makes it possible to rotate the mirror on its pivot until a straight line across it coincides very exactly with the plane of motion of the pendulum. The position is then read to one-twelfth of a degree by a vernier at the edge of the mirror, and a graduated circle of 35 cm. radius on a circular table below. We can continue taking reading for 2½ to 3 hrs. after one start of the pendulum; rotation one degree each 6 minutes, approximately.

Since various writers have described pendulums suspended with piano wire, instead of soft iron wire, and since Professor Longden thought it impossible to get consistent rotation except with wire stretched beyond its elastic limit, or annealed, I wanted to try this effect also; this has not yet been done.

[1] The thickness was later reduced to 5 mm. Two weights, 1125 grams each, placed 66 cm. apart, are thus sufficient counterpoise.

PAPERS IN PSYCHOLOGY AND EDUCATION

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

All but one of the eight papers on the Psychology and Education program were presented at the section meeting. The three which were given but which are not here represented are as follows:

"Contributions of psychology to education," by E. H. Cameron, University of Illinois, Urbana, Illinois.

"Education and the present reorganization of life," by Jordan Caven, Rockford College, Rockford.

"A study of certain rural teachers activities and the adequacy of training for performance," by Ted Ragdale, Southern Illinois State Normal University, Carbondale, Illinois.

Average attendance at the section meeting was about 30, maximum was 35.

Dr. Thomas E. Benner, University of Illinois, Urbana, was elected chairman for the year 1934-35.

(Signed) RALPH W. PRINGLE, *Chairman*

RELATION OF SCHOLARSHIP DURING COLLEGE CAREER TO SUCCESS IN TEACHING JUDGED BY SALARY

H. A. Peterson, Glen Obourn, Hazel and J. M. Wallace, and O. W. Smith
Illinois State Normal University, Normal, Illinois

Studies by Knight[1], Anderson[2], Wagenhorst[3], Ullman[4], and others have conclusively shown that there is little correlation between general scholarship in college and subsequent success in teaching judged by rating of supervisors. This has usually been interpreted as due to the submergence or outweighing of the effects of scholarship by other influences—appearance, a knowledge of people, ability to make friends, aggressiveness, peristence, and other personality traits.

Undoubtedly such factors exert an important influence on success in teaching. But we contend that this is a very inadequate explanation of the low correlation, and that as long as supervisors' rating shows the trend which they do, the matter has not been settled, Rugg[5] showed that supervisors' ratings show a pronounced over-estimation and a congestion of marks in the upper end of the rating scale, and our results confirm this conclusion. This factor alone accounts for a large part of the lowness of the correlation. Furthermore, many of the correlations were not corrected for attenuation.

Until more reliable ratings of supervisors than what we have been able to obtain so far are secured, teachers' salaries are a better, i. e., a more accurate, criterion of success in teaching. They are not influenced by any over-estimation or congestion factor, in fact show a normal distribution.

There have been two studies of the relation of scholarship in college to vocational success judged by salary. Gifford[6] showed a marked correspondence between scholarship and subsequent salary in the employes of the Bell Telephone Company. Gambrill[7] obtained a correlation of .28 between scholarship and salary in teaching in the case of men, and .04 in the case of women. Had her results been corrected for attenuation the correlations would have been larger. There is undoubtedly a sex difference in this matter,—a disinclination to recognize sufficiently differences in merit among women teachers, and also a generally lower salary scale for women, that operates to keep the correlation between scholarship and salary down, in groups composed of both sexes, as in the fifth correlation below.

Our principal contribution to the question is a series of correlations between general scholarship averages during college career and maximum salary during the first five years after graduation. We used returns from the graduates of the two-year classes in the case of elementary teachers, and from the four-year classes in the case of high school teachers and principals—all alumni of the Illinois State Normal University. The classes used were 1924-27 inclusive.

Results

57 principals and secondary teachers, men	.71	P.E. ± .04
95 elementary and secondary teachers, women	.64	P.E. ± .06
47 secondary teachers, women	.22	P.E. ± .10
48 elementary teachers, women	.30	P.E. ± .09
104 secondary teachers, men and women	.43	P.E. ± .05

These correlations have been corrected for attenuation. The correlations for men high school teachers and principals, and for women elementary and secondary teachers are new and significant contributions to the question, and reveal a much higher correlation than has heretofore been thought to

exist. The third and fourth correlations, when compared with the others, also suggest strongly that the lowness of the correlations in some previous investigations is due partly to the small size of the groups, since correlations increase as the square root of the number of cases.

BIBLIOGRAPHY

1. KNIGHT, F. B., Qualities related to Success in Elementary School Teaching. Jour. of Educ. Res., 1922, 5:207-10.
2. ANDERSON, H. J., Correlation between Academic Achievement and Teaching Success. El. Sch. Jour., 1931, 32:22-29.
3. WAGENHORST, L. H., Relation between Ratings of Student Teachers and Success in Teaching. Ed. Adm. and Sup., 1930, 16:249-53.
4. ULLMAN, R. R., Prediction of Teaching Success. Ed. Adm. and Sup., 1930, 16:598-608.
5. RUGG, H. O., Unreliability of Superintendents Ratings of Teachers. El. Sch. Jour., 1920, 20:670-84.
6. GIFFORD, W. S., Does Scholarship in College have any Effect on Success after College? Harpers Mag., 1928.
7. GAMBRILL, BESSIE L., College Achievement and Vocational Efficiency. 1922.

PSYCHOLOGY AND JUVENILE CRIME

BY

MARTIN L. REYMERT, PH. D.

Director, The Mooseheart Laboratory for Child Research

The psychological approach to criminal problems, first advocated by Franz von Liszt, has now taken hold in most countries. In Denmark, the State Attorney General asks the psychiatrist to determine amount and kind of punishment the criminal should have, type of institutional confinement, and other questions.

In juvenile and other crime, the psychologist and psychiatrist are interested in *why* the crime is committed. Thus, we are led to a study of the entire personality pattern of the individual. In every conduct situation there are three variables:

a) the individual with his native and acquired equipment,
b) the social milieu in which he finds himself,
c) a/b-(momentary relationship between the individual and the milieu at the time of executing the act).

The full relationship and bearing of these compound factors can hardly be written at the present time into any definite equation. It all involves greater knowledge than we now possess of human nature. The field of human mentality and motivation is as yet rather obscure. The age-old question of heredity and environment is still perfectly open as regards such large entities as "criminal tendencies". I am unwilling to say that we know much about the nature of intelligence and neither have we reached any ideal means of measurement. Experience has proved to me how little we know in the field of feelings and emotions. Along biological and medical lines, endocrinology seems to give promise for the future but its claims have been over-estimated. I think we can sum up our experience by now in the line of prognosis for the growing individual by saying that the early period of childhood is of great importance. Other periods of importance are around the 4th, 5th, and 6th grades in school, and the adolescent period. Adolescence is the plastic stage of secondary childhood in which new habit, new thought and emotional patterns might be successfully implanted.

When applying their science to juvenile crime, the main thing which the psychologist and the psychiatrist should contribute in the future is the genetic study of the growing individual with special references to factors and patterns of factors which might lead to anti-social conduct.

The specific task of the psychologist should be to explore the relation a/b in the light of what he knows also of *a* and *b* as entities. All psychology is to some degree social psychology.

Instead of using psychological clinics for the study of the juvenile criminal after he is caught, the sensible thing for prevention of crime should be to have clinics in all schools studying the individual from the first grade throughout the system.

I think we shall have to go the whole way and acknowledge the multitude of conditions which might determine the conduct of the bio-social structure of man inside the milieu in which he finds himself. The following are a few of such conditions which we *know* would be helpful:

1) A psychological clinic in each community.
2) Reforms in our schools with the main emphasis on more individualization of instruction and training. The teacher must remember that the child is a *living, growing structure.*

3) Further extension of adult education; reorganization of the training of lawyers and judges to include definite and good courses in branches of psychology and psychiatry which will suit their needs. Similar training for social leaders such as ministers and priests.
4) Continued public and private efforts for betterment of physical and mental health.
5) Non-political State Departments of Public Welfare, where experts can give good service.
6) Government should make available to the individual those things which his very nature rightfully demands (food, housing, education and so forth).

PSYCHIATRY AND THE MODERN CHILD

BY

PAUL L. SCHROEDER, M. D.

Institute for Juvenile Research, Chicago, Illinois

The introduction of psychiatry in the study of children grew out of two movements, mental hygiene on the one hand and the Juvenile Court on the other.

With the contribution of Mr. Clifford Beers in his book, *The Mind that Found Itself*, the organization of a mental hygiene society came first in Connecticut about forty years ago, and subsequently in many other states in this country, and found its culmination in the organization of the National Committee for Mental Hygiene. This movement carried with it a greater understanding of the problems of the mentally ill and more particularly a realization that most mental diseases have their onset in childhood.

Following the beginning of this movement the Juvenile Court came, established first in Chicago. This was the outgrowth of the thinking of men and women concerned with the problems of children. This group believed that delinquent children were not inherently pathological but that their delinquency was in response to unfavorable influences about them combined with physical or mental difficulties. Ten years after the establishment of the Juvenile Court, in 1909, psychiatry entered the picture through the organization of the first Juvenile Psychopathic Institute in connection with the court in Chicago. Dr. William Healy, the first director, together with a staff of psychologists and social workers, pioneered the field, working with children brought to the Juvenile Court. The results of these studies appear in *The Individual Delinquent* and *Mental Conflict and Misconduct* by Dr. William Healy. This was followed by the establishment of similar clinics, notably the Judge Baker Foundation in Boston. In 1917 this service was extended in Chicago to include children with minor behavior difficulties such as truancy, school retardation and, in the younger group, with temper tantrums and minor incorrigibilities. At a later date there were included behavior difficulties such as stammering, bed wetting, feeding problems and shyness. In 1921 the National Committee for Mental Hygiene began to establish local community clinics in large cities throughout the United States and Europe, operated on the same basis as the clinics in Chicago and Boston, connected not only with the juvenile courts but more commonly with children's agencies, public schools, and as separate organizations, totalling approximately 225 clinics in as many cities.

In Illinois, as in several other states, this movement has been extended as the Institute for Juvenile Research and has local community clinics in those cities prepared for and desiring it. Ten Illinois cities are now carrying on a local community clinic in which the professional staff of the Institute serves as examiners and consultants. These clinics operate in the following manner.

The local organizations—including public schools, social agencies and medical societies—co-operate in sponsoring the clinic and inviting the Institute to serve as consultant. They are required to select cases, to provide facilities for the examinations, to provide stenographic service, and to defray the extra expenses of travel of the Institute staff. The functions of the clinic are education and demonstration. Selection is therefore made with a view to including cases which not only are remedial but which will be useful as an educational medium for the public school teachers, the social workers, physicians, parents and other persons properly concerned with the control and direction of the child.

One of the sponsoring organizations in the community must agree to assume responsibility for the organization, supervision and follow-up of the clinic. Of the ten clinics in Illinois, four are carried by the public schools, four by social agencies, one by the Juvenile Court and one by a health agency.

The clinic functions through investigation of the social factors involved, measurement of intelligence, physical examination and psychiatric study. Each of these examinations is conducted by a person especially trained in these fields.

The type of service offered to the child and the community is illustrated in the following case:

A child of twelve was referred for incorrigibility and truancy from home and school. The social investigation revealed a home situation with marked instability and disorganization and an evident lack of academic development in other members of the family, a neighborhood which was run down and in which other delinquent children live. The school reported that the child was failing in the fourth grade.

The physical examination showed a well-nourished, well-developed boy with minor disabilities such as local focal infections limited largely to the tonsils, adenoids and nasal passages.

Intelligence tests revealed this twelve-year-old child to have a mental age of eleven years eight months with an intelligence quotient of .97, and therefore, classifiable in the group of average children, with an educational ability of sixth grade. Because of the discrepancy between the actual grade work and the educational age, educational achievement tests were given which showed that he had a marked reading disability of second grade level with arithmetic of the fifth grade level. Other subjects placed him in the fourth grade.

In response to personal interview with the psychiatrist the child indicated a marked antagonism toward school and a self-evaluation as a stupid child. He rebelled at the academic demands made upon him, and stated that he was biding only the time until he could go to work. His association with delinquent companies was already advanced and admiration for the daring of the older boys was clearly evident.

In this child we found we were dealing not only with the limitations in his social situation which contributed to his disinterest in school, but more particularly with a significant reading disability. His obvious good intelligence was a hindrance rather than an aid in the school room. Because he evidently could do better work his teacher demanded more of him without realizing that until his reading disability was overcome he could not be expected to respond at a level in keeping with his abilities. Thus antagonism had already been established in his relationship with his teacher and had grown with each successive change in teachers. It had reached a point at which he was reacting to the intolerable situation at school by escaping in truancy. This in turn threw him into the company of associates who were experienced in truancy, challenging him and stimulating him far beyond the point which he found in the school room.

Recommendations included social work with the family, treatment of the minor physical disturbances, special instruction directed to overcoming the reading disability and stimulation of his interest in school through a larger participation in the school activities which did not demand academic qualification. It was recommended further that special interest on the part of the teacher or some other person be directed towards giving him the confidence indirectly aimed at changing his point of view towards school.

This represents one of the great variety of behavior problems in children for each of which different causative factors may be found. Individual study becomes necessary and treatment directed towards underlying causative factors.

THE CULTURAL VALUE OF COURSES IN PSYCHOLOGY AND EDUCATION

BY

GEORGE D. WHAM

Southern Illinois State Normal University, Carbondale

Right thinking will justify the study of education *as such* by disclosing two sets of values: First, the *vocational*,—the contribution made to teaching and administration; second, the *cultural*,—the contribution made to a liberal education. This paper contends that the study of education *as such*, over and above its vocational worth, possesses cultural possibilities so distinctive as to make it indispensable in the acquisition of modern culture.

It is necessary to start with a working conception of culture. As the term is here used, a cultural or liberal education is one that *frees* a person —that frees him from ignorance, from awkwardness, from low and destructive attitudes and tastes, from the stultifying effects of superstition and prejudice. To put the matter differently, a liberal or cultural education is one that affords all of the necessary insights into contemporary civilization, as a result of which a person may walk through an intelligible world, understanding and controlling the forces that play upon him, and responding emotionally to that which is good and beautiful and true.

With this conception of culture in mind, I am prepared to affirm that courses in education are liberalizing to precisely the same degree that other courses are liberalizing, that is, to the degree that they furnish insights, understandings, appreciations, and tastes relative to some great department of human life. I shall thus proceed to indicate some of the ways in which the subject of education can create the insights, understandings, appreciations, and tastes necessary to the life of the present day.

In the first place, the study of education affords a set of sympathetic insights into our largest public enterprise, that of public education. No person in the United States, whether he engages in education professionally or not, can afford to be ignorant of this gigantic enterprise. The nature of education, the objectives of education, the curricula of education, the qualifications of teachers, the housing of school-children, and the means of financing the system—all these are matters about which every citizen should be adequately informed and profoundly interested.

In the second place, wholly aside from an understanding of the educational system of the United States, the study of education contributes a range of penetrative insights and emotionalized attitudes as broad and deep as life itself. To illustrate, a study of *educational objectives* brings the student to a consideration of what is worth while in human living, because what is worth striving for in life determines what is worth striving for in education. Again, the study of *educational curricula* brings the student to a consideration of what is most worth while in subject-matter, thus revealing the essential nature of the great body of human culture, its value to the race, and the uses to which it may be put in the cultivation of the individual. Also, a study of education brings a person to a consideration of the *learning process itself* whereby subject-matter may be appropriated, with resulting insights as to how a human being learns, how a human being can be motivated, and how both matter and method can be adjusted to suit the varying needs of individuals. The study of education also trains a person to take into account all of the *imponderable influences* that impinge upon the human mind—the unmeasured but vast influence of music, art, literature, and hu-

man personality, and the multitude of other environmental stimuli that help or hinder the processes of liberalization. And finally, it may be affirmed that the study of education *culminates* in a chastened view of life, a reverential regard for youth, a richer conception of the meaning of education, and a firmer conviction of the necessity of education as a means of preserving and promoting civilization.

We may close with the conclusion that if the conception of culture as a set of sympathetic insights into contemporary civilization is accepted, and if the study of education is so revelatory of profound insights as my analysis has indicated, then we may confidently affirm that the study of education as such makes *an indispensable contribution* to the type of socialized and humanized culture demanded by the present day.

PAPERS IN ZOOLOGY

EXTRACT FROM THE REPORT OF THE SECTION CHAIRMAN

Nineteen papers were listed on the program of the Zoology Section, of which only ten were presented at the meeting. The following paper was given but is not here represented:

"Swimming of the Muskrat," by J. D. Mizelle, University of Illinois, Urbana.

The following paper was read by title only:

"Observations on the stream life of the Charleston, Illinois, region with notes on the food ecology of fishes," by T. L. Hankinson, Michigan State Normal College.

Dr. C. L. Furrow, Knox College, Galesburg, Illinois, was elected chairman of the Zoology section for 1934-35.

(Signed) W. C. SPOONER, *Chairman*

ENTOMOPHAGOUS PARASITISM AMONG THE BEETLES

BY

W. V. BALDUF

University of Illinois, Urbana, Illinois

A small number of beetles may be properly described as entomophagous parasites. Regardless of the fact that they belong to widely diverse taxonomic groups, all, so far as known, have assumed the same type of relation to their hosts. They do not deposit their eggs directly upon the future host, as is done by the parasitic true flies and the ichneumon wasps. The first or primary larval instar resembles a silverfish. It retains its facilities for running about rapidly, and has the responsibility of finding its host or food supply. If successful, the larva begins feeding on the host and subsequently has two or more instars, in each of which its body becomes increasingly bulky and the legs grow correspondingly smaller and weaker. Both these changes obviously result from the availability of an ample supply of food. The fullgrown larva then transforms to an adult in or near the habitat of the host. A few examples of this relationship are given herewith, the development of all, so far as known, possessing the features just described.

1. *Carabidae.* The larva of the bombardier beetle, *Brachinus janthinipennis* has been reared from the pupae of *Dineutes assimilis*, a whirligig beetle, and at least two species of *Lebia* are known to parasitize the larvae or pupae of certain leaf beetles. *Pelecium sulcatum*, related to the Carabidae, is reported from South America as attacking parasitically, soft millipedes, a beetle pupa, and a leaf beetle larva.

2. *Cucujidae. Catogenus rufus* lives upon the pupae of long-horned beetles or the pupae of their braconid parasite, *Bracon dorsatus. Scalidia* spp. are said to be parasitic upon bark-boring beetles.

3. *Bothrideridae.* It is believed that *Bothrideres geminatus* passes its larval stage as an internal parasite of various long-horned beetles, including *Saperda candida.*

4. *Staphylinidae.* The species of the Aleocharinae, as far as known, enter the puparia of the muscoid flies and devour the pupae.

5. *Rhipiphoridae.* The larvae of wasps and bees are the hosts of these beetles in all known cases.

6. *Meloidae.* The adult blister beetles eat the foliage of plants and lay their eggs on or in the soil. The hosts of their larvae are either the egg masses of the common grasshoppers or the eggs and the food stored by parent bees for their young. The primary larva of the first type runs over the ground to find the eggs of the locusts, whereas the second kind climb upon a bee and are thus transported to the bee's cell. No less than 45 species of this family have been recorded as living at the expense of locust egg masses, and at least 21 first eat the bee's egg, then consume the store of nectar and pollen intended for the larvae of the bee.

THE AUTOMOBILE AND WILD LIFE
(ANIMALS KILLED ON A 25-MILE STRETCH OF ILLINOIS HIGHWAY FROM 1930 TO 1933)

BY

W. P. FLINT

Chief Entomologist, State Natural History Survey Division and Illinois Agricultural Experiment Station, Urbana, Illinois

The automobile has had a tremendous effect on many phases of our modern life. It has also had a very marked effect on the wild life in the districts which are traversed by main automobile highways. The following records give some interesting data on the effect of the automobile on the wild life of a prairie area in central Illinois.

The highway on which these records were taken can be considered typical of many of the paved state roads in central Illinois. The records were taken in a twenty-five mile stretch between Urbana, Illinois and Oakwood, Illinois, on state highway No. 10. The road passes through four towns of from 100 to approximately 800 population and also goes close by two other towns of about the same size. Most of the road runs over the level prairie country of central Illinois and passes through a fertile farming area. It crosses two small streams, the Salt Fork near St. Joseph and Stoney Creek near Oakwood. There are several pieces of woodland near the road but it does not actually pass through any forested land. The pavement is nearly all cement in good condition throughout. The Illinois Traction System and the Peoria Branch of the Big Four Railroad closely parallel the road for most of its distance.

TABLE I—*Dead Animals on a 25-Mile Stretch of Illinois Highway.*
May 1, 1930 to December 31, 1930.

Number of observations.	4	4	4	4	2	1	0	1	20
Month.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
ANIMALS OR BIRDS.									
1. Blackbirds	1								1
2. Cats	2		1	6		1			10
3. Chickens	6	4	5	11	3	1		1	31
4. Flickers	2		1	2					5
5. Gophers	10	7	3	10	5	2			37
6. Meadow Larks	1	1	1						3
7. Mice		1							1
8. Muskrats		1							1
9. Owls						1			1
10. Rabbits	4	4	7	4	1			2	22
11. Rats		1		1	1				3
12. Redheaded Woodpeckers	2	1	2	2					7
13. Robins	1								1
14. Skunks	1				1				2
15. Snakes	1				4				5
16. Sparrows (English)	9	23	45	59	6	2		2	146
17. Squirrels					1			1	2
18. Threshers		2	1	1					4
19. Toads			1						1
20. Turkeys	1								1
21. Turtles	1	2							3
Total	41	47	67	96	22	7		7	287
Animals unknown	1	1	4	4	2				12
Birds unknown	2	7	3	6					18
Total	44	55	74	106	24	7		7	317
Number of miles	100	100	100	100	50	25		25	500
Average number of animals per mile	.44	.55	.74	1.06	.48	.28		.28	.634

The speed of cars going along the road will average from 35 to 50 miles per hour. Traffic is moderately heavy. In the summer months one will meet from 80 to 100 cars in driving this stretch of 25 miles. In the winter there will be only about 40 to 80. From counts of cars made on many different days it is certain that from early morning until late in the evening an average of about two cars per minute will pass over a section of the surface of this highway.

The records were made for the most part on Sunday mornings between seven and nine o'clock. They were sometimes made in the afternoon and on other days. The data were taken while driving at 20 to 25 miles per hour with two people in the car, both keeping careful watch on the highway. If a dead animal or bird was seen which could not be readily identified, the car was slowed down or stopped. There was at least a five day interval, in most cases a seven day interval between the records. Previous experience in placing dead animals on this type of highway has shown that it is a very rare for the body of the animal to remain on the road more than three days. In most cases the animal does not remain more than a day. In a few cases the body of the animal may become stuck to the highway and remain in the same place for a week or more.

TABLE II—*Dead Animals on a 25-Mile Stretch of Illinois Highway.*

January 1, 1931 to December 31, 1931.

Number of observations.	2	1	0	3	5	3	4	2	4	1	1	3	29
Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
ANIMALS OR BIRDS.													
1. Blackbirds					2	1	3	1	1				8
2. Bluejays						1							1
3. Cats				2	5	1		1	2	1		1	14
4. Chickens	2			1	4		7	9	3		2	2	30
5. Dogs	1											1	2
6. Doves							1						1
7. Flickers				1		2	3						6
8. Gophers					15	7	7	1	8	1			39
9. Hawks	1			1									2
10. Juncos				1									1
11. Meadow Larks							1						1
12. Moles							1						1
13. Opossum								1					1
14. Owls (Screech)												1	1
15. Pigeons	1												1
16. Rabbits	2			5	2		1			2	1	5	18
17. Rats	1						2						3
18. Redheaded Woodpeckers						4	1						5
19. Robins					1		3		1	1			6
20. Skunks									1				1
21. Snakes				2	1	2	2	3	4				14
22. Sparrows (English)	1			6	8	8	60	31	12		1		127
23. Squirrels	1												1
24. Toads					3	1		1					5
25. Turtles						1	1		2				4
Total	10	0	0	19	41	28	93	48	35	5	4	10	293
Animals unknown					1		1		1				3
Birds unknown					5	3	4	1	3				16
Total	10	0	0	19	47	31	98	49	39	5	4	10	312
Number of miles	50	25	0	75	125	75	100	50	100	25	25	75	725
Average number animals per mile	.2	0	0	.25	.38	.41	.98	.98	.39	.2	.16	.13	.43

Crows have apparently found that a considerable amount of food can be secured along such highways and will very frequently be seen feeding on the carcasses of animals that have been killed by passing automobiles. They will often drag the carcass of a rabbit or other animal or bird off the highway where it can be fed upon with less disturbance. As most of their feeding is done in the early morning, they had in most cases removed only a few animals before the counts were made.

There are several matters of interest in connection with the figures presented. It is quite evident from these figures as well as from previous observations that most of the animals are killed on highways during the months of April to October inclusive. One of the surprising things to those who have occassionally observed the dead animals along highways is the number of English sparrows. These small birds are seen only when driving slowly but are usually completely overlooked if a car is traveling at 35 to 50 miles per hour.

It was quite surprising to note the uniformity of numbers of animals killed each year, particularly in the case of cats and gophers, which varied very little during any of the three years when the observations were made. It seems quite evident from these observations that the only game animal which is killed in any number is the rabbit. The killing of cats can be considered beneficial as they are notorious destroyers of birds and small game. The same may be said of the killing of English sparrows.

TABLE III—*Dead Animals on a 25-Mile Stretch of Illinois Highway.*

January 1, 1932 to December 31, 1932.

Number of observations.	0	3	3	3	6	2	5	4	4	3	2	0	35
Month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total
ANIMALS OR BIRDS.													
1. Blackbirds					1	1				1			3
2. Cat Birds								1					1
3. Cats		1	1	1	2	1	4	1	2	1			14
4. Chickens			1	1	3	4	5	3	4	2			23
5. Dogs				1							1		2
6. Flickers							1						1
7. Frogs								1					1
8. Gophers				1	15	2	10	4	6	4			42
9. Guinea-fowl				1									1
10. Junco				1									1
11. Meadow Lark								2					2
12. Mice		1							1				2
13. Owls (Screech)						1							1
14. Rabbits		2		3	6		5	2	3	3	9		33
15. Rats				1	1					1			3
16. Redheaded Woodpeckers					1		2	1					4
17. Robins					3	1	3						7
18. Skunks									2				2
19. Snakes					6	4		1	4				15
20. Sparrows (English)		1	1	4	27	13	68	37	17	5	2		175
21. Threshers						1							1
22. Turtles						2	1	1					4
Total	0	5	3	14	65	30	99	54	39	17	12	0	338
Animals unknown				1	1		2	2		1		0	7
Birds unknown			1	3	3	5	10	5	1	2	2	0	32
Total	0	5	4	18	69	35	111	61	40	20	14	0	377
Number of miles	0	75	75	75	150	50	125	100	100	75	50	0	875
Average number of animals per mile	0	.07	.05	.24	.46	.7	.88	.61	.4	.26	.28	0	.43

Judging from these data the automobile is not appreciably reducing the numbers of any of our song or insectivorous birds. Of the total number of known animals found dead on this stretch of highway (918), 628 or 68.4 per cent were blackbirds, cats, gophers, mice, rats, and English sparrows. All of these from the human standpoint are more or less undesirable. Reasoning along this line there is grounds for our saying that the automobile is of benefit in reducing the undesirable animals of this region.

Thanks are due for assistance in making these observations to Mrs. W. P. Flint and Dr. M. D. Farrar, both of whom assisted in making a number of these records.

TABLE IV—*Counts of Dead Animals Found on Highways During a Three-Year Period.*

May 1, 1930 to December 31, 1932.

Number of observations.	20		29		35		84
Year.	1930		1931		1932		
	No.	Average number per mile.	No.	Average number per mile.	No.	Average number per mile.	Total.
ANIMALS OR BIRDS.							
1. Blackbirds	1		8		3		12
2. Bluejays			1				1
3. Catbirds					1		1
4. Cats	10	.02	14	.019	14	.016	38
5. Chickens	31	.062	30	.041	23	.026	84
6. Dogs			2		2		4
7. Doves			1				1
8. Flickers	5		6		1		12
9. Frogs					1		1
10. Gophers	37	.074	39	.053	42	.048	118
11. Guinea-fowl					1		1
12. Hawks			2				2
13. Junco			1		1		2
14. Meadow Lark	3		1		2		6
15. Mice	1				2		3
16. Moles			1				1
17. Muskrats	1						1
18. Opossum			1				1
19. Owls (Screech)	1		1		1		3
20. Pigeons			1				1
21. Rabbits	22	.044	18	.025	33	.038	73
22. Rats	3		3		3		9
23. Redheaded Woodpeckers	7		5		4		16
24. Robins	1		6		7		14
25. Skunks	2		1		2		5
26. Snakes	5		14		15		34
27. Sparrows (English)	146	.292	127	.175	175	.200	448
28. Squirrels	2		1				3
29. Threshers	4				1		5
30. Toads	1		5				6
31. Turkeys	1						1
32. Turtles	3		4		4		11
Total	287		293		338		918
Animals unknown	12		3		7		22
Birds unknown	18		16		32		66
Total	317		312		377		1,006
Number of miles	500		725		875		2,100
Average number animals per mile	.634		.43		.43		.48

SEXUALITY AMONG PROSOBRANCH MOLLUSCS

BY

CLARENCE LEE FURROW

Knox College, Galesburg, Illinois

Until recently studies on the sexuality of the Prosobranch Molluscs have been confined almost exclusively to marine genera. In 1914 Von Kemnitz studied a freshwater Bavarian Prosobranchiate, *Valvata piscinalis*, and concluded that this species offered no unusual deviations with respect to hermaphroditism, which was not already present among the pulmonate gastropods. The literature on the marine Prosobranchiates records many unusual conditions connected with reproductive activity, such as protandry, atypical spermatogenesis, vegetative cannibalism, etc. It was thought that the fresh water Prosobranchiates might offer some clews as to the evolution of the reproductive functions among the few remaining hermaphrodite members of this group.

With this in mind attention was directed to the American species, *Valvata tricarinata*. In 1930-31 the author observed atypical spermatogenesis in this species. The atypical spermatogenesis terminates in the formation of two types of abnormal spermatozoa which deviate in size and form with respect to the normal. Further study on this form revealed that the condition of primitive hermaphroditism exists, and that the female germ cells and male germ cells are clearly stratified in the ovotestes. The female germ cells are restricted to the marginal layer and the male germ cells are confined to the central medullary zone.

In 1931-32 Artom and Cavallini re-investigated the European species, *Valvata piscinalis*, and were able to confirm the observations of Von Kemnitz. In addition they studied *Valvata cristata* which is an Italian species. They found *V. cristata* to differ markedly from *Valvata piscinalis* in that *V. cristata* presented a case of spermatozoon dimorphism. They also found that in this case the general histological and morphological conditions of the gonad resemble those of *Valvata tricarinata*. In the observations on *Valvata tricarinata* the segregation of the male and female germ cells is followed during the sexual phases by a period of reduced protandry during which the animal alternates between a male sexual phase and a female sexual phase. The intervals between the two phases are marked by a restoration and a transition, the transition occurring between the male and female phase and the restoration period occurring between the female and the male phase. The atypical spermatogenesis which occurs in *Valvata tricarinata* and the abortive transformation of the spermatozoa are interpreted as arising from the hermaphrodite condition of the animal, especially in view of the segregation of the male and female zones.

SKELETAL MODIFICATIONS IN RIVER CATFISHES OF ILLINOIS

BY

WILLIAM F. HOHEISEL

University of Illinois, Urbana, Illinois

Preliminary observations on the skeletons of the species of *Ameiurus*, *Ictalurus* and *Leptops* seems to indicate that these fishes can be separated out either on the basis of their skulls or their vertebral columns. The nature of these differences can be listed briefly as follows:

1) General shape of skulls: The genera *Ameiurus* and *Leptops* have broad skulls which are flattened dorso-ventrally, whereas the *Ictaluri* skulls are compressed laterally.

2) Brain case: Dorso-lateral margin broadly concave in *Ictalurus;* irregular in *Leptops* and *Ameiurus*. *Leptops* has a wedge-shaped lateral extension of the sphenotic.

3) Subcutaneous dorsal region of the skull: This median portion of the skull which is not covered with muscle is made up of the supraoccipitals, frontals, prefrontals and mesethmoids. The line of attachment of the temporal muscles gives this region a characteristic appearance and limits it laterally.

4) Vertebrae: It seems reasonably certain that they are distinctive for genera. These differences involve the pattern of the sides of the centra and also the character of the zygapophyses. The outstanding marking on the side of the vertebrae is an hour-glass pattern which varies in its shape and proportion relative to the entire centrum. The last few caudals and the more anterior vertebrae are not characteristic, so about one third of the column is needed to insure a diagnosis.

5) The "complex vertebrae" which is made up of the fused 2, 3, and 4th vertebrae, is definitely distinctive for genera and has been found to be useful in the identification of species. The median dorsal keel of the complex is progressively reduced in the genera *Leptops*, *Ictalurus* and *Ameiurus* in the order named.

The skulls of the species of the three genera separate out easily enough. The presence of one-third of the vertebral column would be sufficient for recognition of the genus of the fish and it seems likely that this is adequate for species identification especially if the complex vertebra is also present.

ABNORMALITIES IN THE UTERINE YOUNG OF THE FRESH-WATER SNAIL *CAMPELOMA RUFUM*

BY

NORMAN T. MATTOX

University of Illinois, Urbana, Illinois

ABSTRACT

An observational study of the uterine young of the fresh-water snail *Campeloma rufum* has been made, using materials collected in the Salt Fork branch of the Vermilion River between September, 1933, and May, 1934. Various abnormalities were found in considerable numbers and variations among the normal uterine young. Sinistral forms were noted. Of the total number studied 2.7 per cent were in a twinned or polyvitelline condition. Polyvitelly in the veliger stage was found. One instance of three individuals enclosed within the same membrane was noted. Double monsters with various degrees of fusion of the soft parts with a conjoining of the oral surfaces, bicephalic individuals and a fusion of the foot tissues were the different types found, representing 0.67 per cent of the total number of embryonic young examined. Abnormal shells, such as elongate and asymmetrically coiled shells, flattened, discoidal forms and shells compressed without coiling constitute 2.3 per cent of those studied.

THOMAS SAY, EARLY AMERICAN ZOOLOGIST OF THE MIDDLE WEST

BY

HARRY W. MAUNTEL

Assistant Principal—Mendota Township High School, Mendota, Illinois

There was born in Kingsessing, Pennsylvania, near Philadelphia in 1787 a pioneer in the field of natural science. As was the case the environment was ideal for the future scientist. Philadelphia at this time was the center of culture and education in the United States. In 1812 Thomas Say became a member of the Philadelphia Academy of Natural Science and for the next fourteen years spent his time studying, classifying, traveling and collecting scientific material for the Academy.*

Many papers were prepared and read by Thomas Say while associated with the Philadelphia Academy of Natural Science. A number of these papers were on fossil zoology (shells and crinoids) dealing with the descriptions and classifications made from various collections. It was here that Thomas Say lay the foundations of American Zoology which identify him as the father of American Zoology.

G. D. Harris in his introduction to some of the writings of Thomas Say mentions the fact that he is one of America's greatest naturalists. Too many times European co-workers have overlooked Say's original descriptions of *Exogyra* and credited the genus to Sowerby and too often has Say's work on "Crinoids" been forgotten.[1]

Thomas Say did not confine himself to the study of fossil zoology, but made many discoveries in entomology[6] and became much interested in Herpetology—their descriptions, habits, and the composition of poisons of the poisonous varieties, and cures for snake bite.[2]

In 1826 Thomas Say became interested in the New Harmony movement and went to live in New Harmony, Indiana. In and around the New Harmony community there was an inexhaustable fund of zoological material new to the student of natural science. Therefore, it was the pleasure and honor to Thomas Say to name and describe many scientific specimens new to the scientific world. Thomas Say and other scientists of New Harmony spent much time tramping over the hills and searching the valleys, examining the geological strata of the land and studying the fish and shell life in the Wabash River and its small tributaries.[3]

The descriptions of zoological life by Say were published in the newspaper of New Harmony, called the Disseminator, or in pamphlet form. He also published a book on "Conchology" and listed and named in this book most of the shells found in the Wabash River. This book was printed on the school press by the boys of the School of Industry. The pictures of shells in this book were drawn from nature by his wife who formerly was an artist. It is very interesting to note that these drawings were engraved by the teacher of the Industrial School, Cornelius Tiebout, then the engravings were hand painted in water colors by Mrs. Say. These books were

* Thomas Say made several expeditions to different parts of the United States; one to Florida in 1817; one to the Rocky Mountains (Pike Expedition 1819-1820) and one to the source of St. Peters River in Florida 1823.

[1] Bulletins of American Paleontology. No. V. A Reprint of the Paleontological Writings of Thomas Say. Field Museum Library, Chicago, Illinois.

[2] American Journal of Science, Say on Herpetology, Vol. I., pp. 257-258.

[3] Nora C. Fretageot, Librarian, Thomas Say, Workingmen's Institute Library, New Harmony, Indiana. 1929.

[6] Thomas Say discovered the Colorado beetle commonly called the Potato beetle or bug.

printed in New Harmony in 1830 and are considered of great value among book collectors and of great beauty by art lovers.[4]

The works of Thomas Say are numerous, for today in many of the larger institutions are to be found collections of scientific material.†

After eight years crowded with scientific investigations and writings at New Harmony, Thomas Say fell victim to fever and dysentery which resulted in death October 10, 1834.

Today one may visit the town of New Harmony and look upon many of the works and collections of Thomas Say housed in the Workingmen's Institute and there live again the interesting days of discovery. As the American Journal of Science and Arts states, "It is no exaggeration to assert that Thomas Say has done more to make known the zoology of his country than any other man."

[4] Nora C. Fretageot, Librarian, Thomas Say, Workingmen's Institute Library, New Harmony, Indiana. 1929.

† National Museum, Washington, D. C., Academy Natural Sciences, Philadelphia, Metropolitan Museum, New York, N. Y.

BIOLOGICAL PRINCIPLES UNDERLYING THE FIELD OF EDUCATION

BY

C. E. MONTGOMERY

Northern Illinois State Teachers College, DeKalb, Illinois

The average teacher of biology has come to look upon the field of education as one distant from his own with few or no connections of any worth. In some instances this feeling has grown into an attitude which holds that educational material is of no value to the general student. On the other hand, education outside the field of biology has come to look upon the processes of life as casual without ever realizing that they are the only activities of the human machine.

Psychologists speak of the types of energy in the various mental processes but with little or no understanding of its real meaning. The work of the physiologists has shown without doubt that the work of the nerve cells is the result of the expenditure of energy just as in muscles and other organs. This energy releasal process is initiated by some energy disturbance in the environment, directly or indirectly, such as light, sound, pressure, etc., all of which are called stimuli. It has its effect in some muscle, gland or nerve reaction. The nature of this final reaction is determined by the intensity of the stimulus and chemical set up in the responsive machinery. Space does not permit any discussion of the factors in the chemical set up but it may be sufficient to say that so far as education of the individual goes it is about the most important feature involved. The problem of the weak student is not a lack of proper environmental influences so much as it is a non-receptive chemical machine on the inside. The bright student is just the reverse. He not only is able to release an abundance of energy when provoked by stimuli, but can direct it into useful channels. The subnormal child is more a medical than a psychological problem. Initiative and genius are expressions of mental machines that are aroused by stimuli which do not reach the common person.

Volumes have been written covering the various phases of the mental activities, but to the average beginning student and teacher there is nothing but a misty haze of technical terms to confuse them. Much stress is placed upon training of leaders and thinkers without any question as to the possibility of doing either. Urges, emotions, reflexes and all other psychological acts have a chemical basis. Learning, therefore, is not a mere matter of being exposed to certain environmental relations but an actual releasal and usage of mental energy. The individual who may have a good mental machine and does not use it, is little or no better off than the person who may have a poor one. The successful teacher is the person who can arouse and inspire individuals to a definite and positive mental action.

Modern educational research has done a great deal to improve the work in the field of instruction but at the present stage it has not reached the bottom of the problem. Researchers in education will have to meet the biologist and, together they may be able to move forward in their work. Education is a biological adaptation. If the average thinking person can be brought to this level of understanding, the study of problems in all phases of human adjustment will be placed on a much saner foundation. Every teacher should have a clear knowledge of the importance of heredity and its early environmental relations. It is probable that more damage is done to the pre-school child than to the child in school. Many teachers in zoology and biology do not recognize the importance of this phase of their work.

LIVING VS. DEAD

BY

SISTER M. STANISLAUS R. S. M.

Mercy High School, Milwaukee, Wisconsin

Since Biology is the study of living things, it seems fitting that the living as well as the dead should find a place in a scientific workshop. Every laboratory worthy of the name has at least one aquarium but seldom is any other life found there.

Plenty of preserved specimens are found in the supply rooms and from them students may learn much regarding both the external and internal structure.

Where General Biology is taught the frog or the pig is frequently used. The latter is more valuable, though the frog is more frequently used. The reason is because of the heart of the pig. Should we dissect simply for dissection sake or should we do so the better to appreciate ourselves and our place in creation?

Why, may I ask, do most teachers rest satisfied with only lifeless material? The answer is obvious; they abhor the extra work necessitated by the presence of living animals who need care. The lifeless material needs only a place. Such living specimens as white rats, frogs, and birds need abodes where they can and will contentedly live. These need to be kept clean and that work falls to the teacher.

The teachers, therefore, protest against the housing of them in a laboratory; the students, on the contrary, enjoy them and can learn much concerning them. This first hand knowledge seems practical. Such a display enables students to compare animals with humans, teaching them to be grateful to their Creator for all they have which raises them to a higher level than the dumb animals before them. Man has been gifted with five senses, each of which, unless diseased, is keen. In the animal every sense is not equally keen. For instance, the white rats have been endowed with a keen sense of hearing and of smell but their sight is quite deficient. Watching such animals scent around for food ought to inspire any thinking student with gratitude that he is blessed with five senses equally keen and hence is superior to lower animals of the mammalian phylum.

Many, blinded by prejudice, are of the unchangeable opinion that animals are disease spreaders. Especially is the albino rat so condemned. Yes, rats are, but can not circumstances alter cases even in the brute creation? The common pest, the alley rat, lives among filth, eats filth, and seems contented only in filth. Usually, too, it is infested with fleas, the bite of which may prove disastrous to the human whom it may attack.

Is our tamed albino to be so catalogued? The white rat of the laboratory has or should have an abode that can be easily and daily cleaned. He favors cleanliness. He should be fed with proper food, including milk and lettuce. Rats that are given care will not wander far from their cage but will hover near to return to it when it is ready. Well-cared for rats are as playful as kittens when they are allowed to romp around the laboratory.

As teachers, it is our duty not only to present material but also to arouse interest in every possible way. Most educators will agree that the average student dreads the study of science. The secret of the teacher's success is in the manner of presentation.

What is there more interesting than life? Nothing, therefore, I hold that a well-equipped laboratory should have not only the essential preserved material that will tend to effective teaching but also live specimens. Proud should a teacher be who can proclaim that she has living in her laboratory one or more of each type of vertebrate.

A STUDY OF CHARACTERS FOR THE DIFFERENTIATION OF TWO SPECIES OF MINNOWS OF THE GENUS *NOTROPIS*

BY

W. C. STARRETT

University of Illinois, Urbana, Illinois

ABSTRACT

Notropis whipplii and *N. lutrensis* are two species of Illinois minnows which are frequently confused and are often said to intergrade. These two species have been studied to determine to what extent internal characters are available for differentiation. It has been found that while the number of gill rakers tends to be distinctive for each species, there is some intergradation. In similar manner while each species has a characteristic pharyngeal tooth formula, some individuals show variations from the normal that tend to run the two sets of observations together.

Anatomical details to some extent confirm the statements of Forbes and Richardson concerning the intergradation of these two species. However, a statistical analysis of variability in number of pharyngeal teeth and in number of gill rakers for each species reveals the fact that each has a characteristic range of variability. This variation has no observable correlation with length of body. In *N. whipplii* the formula for pharyngeal teeth varies from 4-3 to 1, 4-4, 1, and in *N. lutrensis* from 3-3 to 1, 4-4, 1. The mean for the former is 1, 4-4, 1; for the latter 4-4. *N. whipplii* has 9 to 12 gill rakers in the lower limb, while *N. lutrensis* has 12 to 14 in the material studied.

SEASONAL LIFE HISTORY OF A SNAIL OF THE GENUS *FOSSARIA*

BY

HARLEY J. VAN CLEAVE

University of Illinois, Urbana, Illinois

ABSTRACT

A snail, *Fossaria modicella*, previously reported from a peculiar habitat at Turkey Run, Indiana, where it lives on vertical sandstone cliffe, has been under observation for a number of years. Collections have been made periodically, analyzed and correlated with field observations to determine facts in the life history. Periods of egg production have been observed and their subsequent influence on size range of individuals noted. An analysis of distribution curves based on size of shells furnishes the basis for predicting the time of appearance of new generations in cyclic repetition of similar population samples.

Full details of this investigation are to appear in *Ecology*.

A BIBLIOGRAPHY OF THE ECOLOGY OF ILLINOIS, PART 1

A PROJECT OF THE ACADEMY'S COMMITTEE ON ECOLOGICAL SURVEY

COMPILED BY

ARTHUR G. VESTAL

University of Illinois, Urbana, Illinois

About five years ago the chairman of the Committee on Ecological Survey, Dr. E. L. Stover, submitted to the Academy a Bibliography of Ecological Literature on Illinois Flora and Fauna. This was given to the writer as his successor, for its enlargement and publication, with the help of the other members. A plan for completing the work was approved at a meeting of the committee in May, 1930. Somewhat radical departures from this plan gradually developed. During the more active later phase of preparing the bibliography, the conviction grew that annotations of many of the titles were essential, to show wherein their ecological content or bearing lies, or to make known the occurrence of hidden gems of ecological significance, especially in older descriptions of vegetation or animal life now extinct in that locality, or to serve as very brief abstracts of their ecological import. These annotations are the more valuable if the publications themselves are not readily accessible.

Another direction of enlargement has been considered indispensable. That is the inclusion of materials outside the boundaries of our state which bear directly upon Illinois environments, organisms, or communities. A knowledge of publications dealing with adjoining states as a whole, or with the counties or districts closest to Illinois is a necessary part of the equipment of every Illinois biologist, ecologist, geographer, agriculturist, forester, meteorologist, and soil scientist.

One difficulty has been to decide what non-ecological writings have sufficient ecological import to be included. The field ecologist finds value in those studies in physical geography which elucidate topography, substratum, soil character, climate, and environmental history, particularly that of glacial and post-glacial events. For this reason such articles are more likely to be included than not, as well as certain others which give locational details in particular areas in which Illinois ecologists are interested. Likewise, floral and faunal lists, and less comprehensive locality records, especially in the older publications, are necessary equipment. Pertinent accounts in early travels, and certain passages in works on the history of Illinois and its settlement, are also referred to.

For about one-third as many citations as here appear, references not yet completed are on hand. It is expected that in about two years, the second sizable part of the bibliography will be ready, with a grouping-together of the more important citations for certain subjects in a partial index. This will cover both parts.

Among the titles and annotations herein are more than a few of interest in many other regions than Illinois and the middle west. Some of the discussions of the "causes" of the treeless condition of prairie country are a

contribution to the nearly world-wide problem of tree or bush vegetation as waging a never-ending struggle with grassland. Other problems of more than local interest are similarly approached.

In the citations, the date appearing at the left is the year in which the volume or the particular article was *issued*. If the volume containing the article was issued at a later time, that may be given in parentheses at the end. But most citations with two dates are for annual proceedings or reports in which the time of issue is one year or in a few cases two years later than the date prominently shown on cover or title-page which is the date in parentheses in the citation. Thus Vol. 10 of Trans. Ill. Acad. Sci. is the volume *for* 1917, but was published in 1918.

The compiler will be most grateful for additional citations that may be sent in by users of the bibliography. Some of them may duplicate titles now on hand, but in more cases may complete them or be new references. Titles of papers which are not to be included in either Part 1 or Part 2 because of limited scope or interest, will be kept filed on cards at the University of Illinois, Department of Botany, and may be consulted there as a supplement to the printed bibliography.

The compiler's obligation must be expressed, first to Dr. Stover, who assembled the nucleus of titles, and to other members of the committee who have contributed citations from time to time. The other members of the committtee are:

W. G. Waterman, Northwestern University, Evanston.
V. O. Graham, 4028 Grace Street, Chicago.
V. E. Shelford, University of Illinois, Champaign.
W. C. Allee, University of Chicago, Chicago.
L. E. Sawyer, State Natural History Survey, Urbana.
C. E. Montgomery, State Teachers College, DeKalb.
John Voss, Manual Training High School, Peoria.
Mary M. Steagall, Southern Illinois Normal University, Carbondale.

ABEL, ARTHUR A. See SPIKER, CHARLES J.

ADAMS, CHARLES C.

1902 Southeastern United States as a center of geographical distribution of flora and fauna. Biol. Bull. 3:115-131. [Ill. fauna of s. e. origin, center localized about Chattanooga.]

1904 The migration route of Kirtland's warbler. Bull. Mich. Ornith. Club 5:14-21. [Migrates up Mississippi, Illinois, Wabash, and Ohio valleys, in the manner of the prothonotory warbler.]

1913 Guide to the study of animal ecology. New York. Macmillan Company. 183 pp. [Consists in large part of annotated bibliography.]

1915 An outline of the relations of animals to their inland environments. Bull. Ill. State Lab. Nat. Hist. 11:3-32.

1915 An ecological study of prairie and forest invertebrates. Bull. Ill. State Lab. Nat. Hist. 11:33-280. See HANKINSON, 1915.

ADAMS, GEORGE I.

1900 Physiography [of the Ozark region, Mo. and Ark.] 22d. Ann. Rept. U. S. Geol. Surv., Part 2, Chap. 2, pp. 69-75.

ADAMS, ROBERT P.

1930 Weed succession of an abandoned roadway. Proc. Iowa Acad. Sci. 36:213-219. (1929). [E. Iowa co., s. of Amana; same road as in SHIMEK'S "Artificial prairie," 1913. Part of bare roadbed abandoned, 1925. First weeds, then prairie plants, then forest plants, established.]

1931 Notes on Iowa grasses. Proc. Iowa Acad. Sci. 37:91-94. (1930). [About 25 spp., less abund. in Iowa or recently introduced.] See PAMMEL, L. H., 1903.

ADCOCK, FLORENCE

1923 Ecological survey of the fauna of Lake Knox. Trans. Ill. State Acad. Sci. 15:186-199. (1922). [See HOUDEK 1924.]

AGERSBORG, H. P. K.

1929 The biology of sewage disposal. A preliminary study. Trans. Am. Micros. Soc. 48:158-180.

1930 Does high temperature in a frigid country limit diversification of the species? Trans. Ill. State Acad. Sci. 22:103-114. (1929). [Organisms of starch-waste effluent, corn products plant at Decatur.]

1930 The influence of temperature on fish. Ecology 11:136-144. [Lake Decatur, Ill.]

AGRONOMY DEPARTMENT, UNIVERSITY OF ILLINOIS.

1934 Illinois soil type correlations. Univ. Ill. Agr. Exp. Sta. Mimeographed. Three articles, 11, 11, and 10 pp. [Relates new place names and type nos. of Ill. soils to old descriptive names and nos., and to U. S. Bur. Chem. and Soils names. Also rates soils as to degree of productiveness for gen. agriculture, pasture, and timber.]

1934 Illinois soil type description sheets. Univ. Ill. Agr. Exp. Sta. Mimeographed. 296 pp.

AIKMAN, J. M.

1929 Competition studies in the ecotone between prairie and woodland. Proc. Iowa Acad. 35:99-103. (1928).

1930 Secondary plant succession on Muscatine Island, Iowa. Ecology 11:577-588.

ALDEN, W. C.

1918 The Quaternary geology of southeastern Wisconsin. U. S. Geol. Surv., Prof. Paper 106. 356 pp.

ALEXANDER, C. P.

1925 An entomological survey of the Salt Fork of the Vermilion River in 1921, with a bibliography [76 pp.] of aquatic insects. Bull. Ill. Nat. Hist. Surv. 15:439-535.

ALEXANDER, H. C., AND McCURDY, G. E.

1916 Report of survey and proposed improvement of the Fox River. River and Lakes Commission, State of Ill., Springfield. 106 pp.

ALLEE, W. C.

1912 Seasonal succession in old forest ponds. Trans. Ill. State Acad. Sci. 4:126-131. (1911).

1914 The ecological importance of the rheotactic reaction of stream Isopods. Biol. Bull. 27:52-66.

ALLEN, J. A.

1869 [Birds of] northern Illinois., Pp. 502-522 of: Notes on birds observed in western Iowa, ... northern Illinois, ... and at Richmond, Wayne Co., Indiana. Mem. Bost. Soc. Nat. Hist. 1:488-526. [Ogle Co., and Cook Co.]

1870 The flora of the prairies. Am. Nat. 4:577-585. [N. Ill., centr. & w. Iowa.]

1871 The fauna of the prairies. Am. Nat. 5:4-9.

1871 Notes on the mammals of Iowa. Proc. Bost. Soc. Nat. Hist. 13:178-194. [Some Ill. records also.]

ALLEN, V. T.

1930 Petrographic studies bearing on the genesis and morphology of Illinois soils. 2d. Internat. Congr. Soil Sci. 5:113-117.

ALLYN, W. P., AND RETTGER, L. J.

1933 Fresh-water medusae at Terre Haute, Indiana. Proc. Ind. Acad. Sci. 42:259-260.

ALVORD, CLARENCE W.

1920 The Illinois country, 1673-1818. Centenn. Hist. of Ill. vol. 1. Springfield. 524 pp. See BUCK, S. J., 1917, and PEASE, T. C., 1919.

ALVORD, JOHN W., AND BURDICK, CHARLES B.

1915 Report of the Rivers and Lakes Commission on the Illinois River and its bottom lands, with reference to the conservation of agriculture and fisheries and the control of floods. Ill. Dept. Public Works & Bldgs., Div. of Waterways. 141 pp.

1915 Maps of the Illinois River and its bottom lands. Rivers and Lakes Comm., Springfield. 10 sheets.

AMOS, JOHN M.

1933 A list of the Coccidae of Tippecanoe County and their hosts (Homoptera). Proc. Ind. Acad. Sci. 42:205-208. Descriptions of certain of these, pp. 208-211.

ANDERSON, RUDOLPH M.

1907 The birds of Iowa. Proc. Davenport Acad. Sci. 11:125-417.

ANDREWS, EDMUND

1860 A trip in southern Illinois. Prairie Farmer 22: (new ser. 6:) 51. [Bald Knob at that time forested to summit.]

1870 The North American lakes considered as chronometers of post-glacial time. Trans. Chi. Acad. Sci. 2:1-23.

ANONYMOUS

1860 The first field meeting of the Chicago Academy of Sciences. "To Cobden and return." Prairie Farmer 22: (new ser. 6:) 1-3. [Transportation provided free to nearly 100 members by the Ill. Central R. R. Co. Lists of plants seen en route, and about Cobden.]

Account of 2d meeting, at Lake Forest, 22:66-68.

Account of 3d meeting, not found.

Account of 4th meeting, Dubuque, 22:389.

["Oak Ridge" w. of Chicago, said to have post oak and black-jack oak. Hardly likely.]

ARMINGTON, JOHN H. See COX AND ARMINGTON.

ARTHUR, J. C.

1876 Contributions to the flora of Iowa; a catalogue of the phaenogamous plants. Charles City: "Intelligencer" Book Print. Publ. for the International Exhibition, by the Iowa Centennial Commission. 43 pp. [Lists 979 spp. No habitat or locality records. Appendix, pp. 39-43.]

1925 The Uredinales (rusts) of Iowa. Proc. Iowa Acad. Sci. 31:229-255. (1924). [Host data and host index.]

ATHY, L. F.

1928 Geology and mineral resources of the Herscher quadrangle. Ill. State Geol. Surv. Bull. no. 55. 120 pp. [At south border of the broad valley of the lower Kankakee.]

ATWATER, CALEB

1850 The Indians of the Northwest, their manners, customs, &c, &c, or Remarks made on a tour to Prairie du Chien and thence to Washington City in 1829. Columbus, O. 296 pp.

ATWELL, C. B.

1932 Three dune associations compared. Torreya 32:109-115. [N. J. coast; Beach, Ill.; Seaside, Ore.]

ATWOOD, W. W., AND GOLDTHWAIT, J. W.

1908 Physical geography of the Evanston-Waukegan region. Ill. Geol. Surv. Bull. no. 7. 102 pp. Reprinted 1925.

AVERITT, S. D.

1915 Soils of Kentucky. Ky. Agr. Exp. Sta. Bull. no. 193:129-164.

BABCOCK, H. H.

1872 The flora of Chicago and vicinity.
The Lens 1:20-26, 65-71, 144-150, 218-222.

1873 The Lens 2:33-44, 96-98, 248-250.

1872 On the effect of the reversal of the current of the Chicago River on the hydrant water. The Lens 1:103-106. [River backed up by high lake level. Water from crib intake two miles off shore shows radical difference in amount and composition of plankton.] See also brief note on p. 120.

BAILEY, E. S.

1917 The sand dunes of Indiana: the story of an American wonderland told by camera and pen. A. C. McClurg & Co., Chicago. 165 pp.

BAKER, FRANK COLLINS

1898 The Mollusca of the Chicago area. Chicago Acad. Sci., Nat. Hist. Surv. Bull. no. 3. Part I. The Pelecypoda, pp. 1-130, pls. 1-27.

1902 Part II. The Gastropoda, pp. 131-410, + 8 p. index, pls. 28-36.

1906 A catalogue of the Mollusca of Illinois. Bull. Ill. State Lab. Nat. Hist. 7:53-136.

1908 The Chicago Academy of Sciences: its past history and present collections. Chicago Acad. Sci., Special Publ. no. 2. 7 pp. Historical acct. condensed from W. K. Higley's paper, spec. Publ. no. 1, 1902.

1910 The ecology of the Skokie Marsh area, with special reference to the Mollusca. Bull. Ill. State Lab. Nat. Hist. 8:441-499.

1912 Post-glacial life of Wilmette Bay, glacial Lake Chicago. Trans. Ill. State Acad. Sci. 4:108-119. (1911).

1920 The life of the Pleistocene or Glacial period. Univ. Ill. Bull. 17, no. 41. 14 + 476 pp. [Very extensive bibl. on glacial history of e. U. S. and on Pleistocene organisms.]

1922 The molluscan fauna of the Big Vermilion River, Illinois. Ill. Biol. Mon. 7 (2):105-224. 15 pls. [Modification by pollution emphasized.]

1927 The naiad fauna of the Rock river system: a study of the law of stream distribution. Trans. Ill. State Acad. Sci. 19:103-112. (1926). [Ecol. differences between upper and lower parts of river are emphasized.]

1928 Molluscan life of the loess deposits of Illinois. Trans. Ill. State Acad. Sci. 20:269-292. (1927).

BAKER, FRANK COLLINS—*Continued*

1928 The fresh water Mollusca of Wisconsin. Part I. Gastropoda. Part II. Pelecypoda. Wis. Geol. and Nat. Hist. Surv. Bull. 70. 20 + 507, and 6 + 482 pp. 105 pls. Bibl., v. 2, pp. 430-452.—Review by H. J. Van Cleave in Ecology 11:228-229. [Most Ill. spp. incl. in this monograph.]

1929 A study of the Pleistocene Mollusca collected in 1927 from deposits in Fulton county, Illinois. Trans. Ill. State Acad. Sci. 21:288-312. (1928).

1929 The European starling in Illinois. Science 69:521-522.

1930 The molluscan fauna of the southern part of Lake Michigan and its relationship to old glacial Lake Chicago. Trans. Ill. State Acad. Sci. 22:186-194. (1929).

1930 A review of our present knowledge concerning the character and distribution of the Pleistocene aquatic molluscan life of Illinois. Trans. Ill. State Acad. Sci. 22:411-435. (1929).

1930 The use of animal life by the mound-building Indians of Illinois. Trans. Ill. State Acad. Sci. 22:41-64. (1929).

1931 Additional notes on animal life associated with the mound-builders of Illinois. Trans. Ill. State Acad. Sci. 23:231-235. (1930).

1931 Pulmonate Mollusca peculiar to the Pleistocene period, particularly the loess deposits. Jour. Paleont. 5:270-292. [Part of time of loess-deposition considered cooler than at present in centr. and s. Ill.]

1931 Ecological relationship of the genus Pomatiopsis with special reference to P. lapidaria. Ecology 12:489-496.

1932 Pleistocene history of the terrestrial mollusca of Fulton county, Illinois. Trans. Ill. State Acad. Sci. 24:149-155. (1931).

BALDUF, W. V.

1925 The feeding of a common tiger beetle, (Cicindela punctulata). Ent. News 36:275-276.

1926 Notes on the habits of Rhinoncus pyrrhopus Boh. Trans. Ill. State Acad. Sci. 18:178-183. (1925).

1926 On the habits and development of a checkered beetle (Cymatodera undulata). Trans. Am. Ent. Soc. 52:29-37.

1926 On the bionomics of some Hymenoptera from a bur oak cynipid gall. Can. Ent. 58:135-143, 157-164.

1926 The bionomics of Dinocampus coccinellae Schrank. Ann. Ent. Soc. Am. 19:465-498.

1928 Observations on the buffalo tree hopper (Ceresa bubalis Fabr., Membracidae, Homoptera), and the bionomics of an egg parasite (Polynema striaticorne Gir., Mymaridae, Hym.). Ann. Ent. Soc. Am. 21:419-435.

1929 The bionomics of Tetrastichus verrucarii (Chalcidoidea) with notes on its hosts (Neuroterus spp., Cynipidae) on burr oak. Can. Ent. 61:125-130. See also 61:221-222.

BALL, E. D.

1897 Notes on the orthopterous fauna of Iowa. Proc. Iowa Acad. Sci. 4:234-241. (1896).

BALL, JOHN R., AND POWERS, WILLIAM E.

1930 Shore recession in southeastern Wisconsin. Trans. Ill. State Acad. Sci. 22:435-441. (1929).

BALL, T. H.

1873 Lake county, Indiana, from 1834 to 1872. Chicago. J. W. Goodspeed. 364 pp. [Description of topogr., veg., prairies, pp. 10-16; isolated groves, pp. 259-261; animals, pp. 246-249, 263-264.]

1884 Lake county, Indiana, 1884 . . . with historical papers and other interesting records . . . Crown Point, Ind. 486 pp. Contains biological descriptions by E. W. DINWIDDIE (pp. 150-157) and BALL (158-175).

[BALL, T. H., AND HENRIETTA BALL]

1884 The flora of Lake county. Pp. 158-174 of BALL, 1884, q. v. [Brief descriptions of: sand ridges and marshes near L. Mich., forests and groves s. of Little Calumet river; prairie; Calumet marshes; bottom forests of the Kankakee. 239 plant spp. det. by HENRIETTA BALL are listed, pp. 166-171. No annotations. Groves descr. separately, pp. 171-174.]

BANKS, NATHAN

1907 A preliminary list of the Arachnida of Indiana, with keys to families and genera of spiders. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 31:715-747. (1906).

BANNISTER, HENRY M.

1868 [Prairie and forest in Cook county.] Ill. Geol. Surv. 3:239-240.

BARNES, M. G.

1922 Floods in Illinois in 1922: causes, results, and remedies. Div. of Waterways, State of Ill., Springfield. 29 pp., with folded profile.

BARNES, R. M.

1890 List of birds breeding in Marshall county, Ill. Ornithologist and Oologist 15:113-116. [107 spp., incl. many water birds of Ill. River bottoms. Annotated.]

BARNES, W. D., REPPERT, FRED, AND MILLER, A. A.

1900 The flora of Scott and Muscatine counties [Iowa]. Proc. Davenport Acad. Sci. 8:199-287. [Abundance and habitat notes; occas. locality records. 1068 spp. listed. Flora of Wild Cat Den specially mentioned: this is now a state park. At the end are reprinted articles on Cnicus Hillii and Quercus ellipsoidalis by E. J. HILL.]

BARNEY, R. L., AND ANSON, B. J.

1920 Life history and ecology of the pigmy sunfish, Elassoma zonatum. Ecology 1:241-256.

1923 Life history and ecology of the orange-spotted sunfish Lepomis humilis. U. S. Bur. Fish, Doc. no. 938. 16 pp. [Work done at Fairport, Iowa.]

BARRETT, EDWARD

1917 The dunes of northwestern Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 41:11-27, and 2 maps. (1916). [L. Mich. and Kankakee valley sand areas.]

1917 The beautiful Shades. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 41:80-89. (1916). [S. w. Montgomery co., on Sugar Creek.]

BARROWS, H. H.

1910 Geography of the middle Illinois valley. Ill. Geol. Surv. Bull. no. 15. 128 pp. Reprinted 1925.

BARTON, J. E.

1919 The amount of standing timber in Kentucky. Dept. of Geol. and Forestry. Mineral and Forest Resources of Ky. (Ser. 5) 1:251-284.

BAUER, F. C.

1930 Response of Illinois soils to systems of soil treatment. Univ. Ill. Agr. Exp. Sta. Bull. 25:435-514c (no. 362). [Ill. soil-classification, p. 439; map, 440; Appendix, 514 a-c, gives type names, N, P, and pH data for 10 soil groups.]

BEAL, W. J.

1870 A stroll along the beach of Lake Michigan. Am. Nat. 4:356-358. [South of Chicago: strand and dune plants apparently as in Indiana dunes.]

BEBB, M. S.

1859 List of plants occurring in the northern counties of the state of Illinois, in addition to the catalogue given by Dr. I. A. Lapham. Trans. Ill. State Agr. Soc. 3:586-587. (1857-8).

1860 The flora of Ogle and Winnebago Cos., Ill. Prairie Farmer 22: (new ser. 6:)182-183. [The numbers appearing on these pages are 172-173, since pp. 176-192 were misprinted as 166-182. This article is on the *second* pair of pages numbered 172 and 173.—Plants characteristic of the following habitats: stream margins, level valley (presumably of Rock River) with prairie grasses and herbs; forested bluffs; rolling prairie of thinner soil near bluffs; higher prairies. Also describes: the groves, mostly in valleys, tree species few, incl. scrubby bur oak; hazel border or "ruff"; plants of Black Hawk's Pulpit (Castle Rock).]

BECK, LEWIS C.

1823 Gazetteer of the states of Illinois and Missouri, with map and general description. 8vo. Albany, N. Y. 352 pp., maps.

1826 to 1828 Contributions towards the botany of the states of Illinois and Missouri. Am. Jour. Sci. and Arts 10:257-264. 1826.—11:167-182. 1826.—14:112-121. 1828. [From Beck's records I have made a list of 65 plants that he found in prairies near St. Louis, and 14 spp. in barrens. Other habitats were noted. Abundance and seasonal data also given. Many of the records are from the Illinois River bluffs and valley.]

BECKWITH, HIRAM W.

1884 The Illinois and Indiana Indians. In vol. 27 of Fergus' Historical Series, pp. 99-183. Chicago. Fergus Printing Co.

BEEDE, J. W.

1911 The cycle of subterranean drainage as illustrated in the Bloomington, Indiana, quadrangle. Proc. Ind. Acad. Sci. 1910:81-111.

BEHRENS, OTTO, JR.

1928 The ferns of Turkey Run. Proc. Ind. Acad. Sci. 37:377-379. (1927). See TEST, F. H., 1930.

BENEDICT, A. C., AND ELROD, M. N.

1893 A partial list of the flora of Wabash and Cass counties [Ind.] with notes. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 17:260-272. (1891).

BENKE, H. C.

1929 Notes on the fall-flowering plants of the central Mississippi river valley. Rhodora 31:145-151.

1932 Floristics of a young lake. Am. Bot. 38:74-79.

BERRY, GEO. H.

1915 A list of the Lepidoptera of Linn county, Iowa. Proc. Iowa Acad. Sci. 21:279-316 (1914). [Degree of abundance given. 6608 spp. listed.]

BLAGG, BETTY

1928 Preliminary list of Iowa mosses. Proc. Iowa Acad. Sci. 34:125-132. (1927).

1929 to 1931 Additional notes on Iowa mosses. Proc. Iowa Acad. Sci. 35:113-116. (1928); 36:137-139. (1929); 37:96-98. (1930).

BLANCHARD, FRANK N.

1925 A collection of amphibians and reptiles from southeastern Missouri and southern Illinois. Papers Mich. Acad. Sci. 4:533-541. (1924).

BLANCHARD, W. O.

1924 The geography of southwestern Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. no. 65 (Educ. Ser. no. 8). 117 pp. [Map of prairie and forest, after Martin, p. 67.]

BLATCHLEY, W. S.

1891 Notes on the Batrachians and reptiles of Vigo county, Indiana. Jour. Cincinnati Soc. Nat. Hist. 14:22-35.—Supplement with same title, Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 24:537-552. (1899). 1900.

1891 to 1898 Some Indiana Acrididae. Series in Can. Ent.
1891 I. 23:74-81, 98-100.
1892 II. 24:28-34.
1894 III. 26:217-223, 241-245.
1898 IV. 30:54-64.

1893 The Locustidae of Indiana. Proc. Ind. Acad. Sci. 1892:92-153.

1893 The Blattidae of Indiana. Proc. Ind. Acad. Sci. 1892:153-165.

1893 A catalogue of the butterflies known to occur in Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 17:365-408. (1891).

1895– Notes on the winter insect fauna of Vigo county, Indiana. Psyche

BLATCHLEY, W. S.—*Continued*

1896 7:247-250, 267-270, 279-281.—1896 7:336-340, 379-381, 399-401, 434-437, 455-458.

1897 Indiana caves and their fauna. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 21:121-212. 10 pls. (1896).

1897 A catalogue of the uncultivated ferns and fern allies and the flowering plants of Vigo county, Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 21:577-708. (1896). [Topogr. and soils, p. 580–; prairie near Heckland, p. 581. Notes on habitat, abundance, phenology, etc.]

1898 The geology of Lake and Porter counties, Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 22:25-104. (1897). [3 districts: Calumet or northern, morainic or middle, and Kankakee or southern. Swamp prairies and wooded "sand islands" of the Kankakee flats, pp. 65-67. Faunal notes, pp. 89-92. Floral notes, 92-102, incl. annotated list of 103 spp.]

1899 Gleanings from Nature. Nature Publ. Co., Indianapolis. 348 pp. 15 pls.

1903 The Orthoptera of Indiana; an illustrated descriptive catalogue of the species known to occur in the state, with bibliography, synonymy, and descriptions of new species. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 27:145-471. (1902). [Ill. records are included.]

1904 The Indiana of Nature—its evolution. Proc. Ind. Acad. Sci. 1903: 33-59.

1909 The life zones of Indiana as illustrated by the distribution of Orthoptera and Coleoptera within the state. Proc. Ind. Acad. Sci. 1908:185-191.

1910 An illustrated descriptive catalogue of the Coleoptera or beetles (exclusive of the Rhyncophora) known to occur in Indiana. Publ. by the author, Indianapolis. 1386 pp.

1912 The Indiana weed book. Nature Publ. Co. Indianapolis, 191 pp. Bibl., p. 182.—3d ed., 191 pp. 1930.

1917 A century of geology in Indiana. Proc. Ind. Acad. Sci. 1916:89-177.

1920 Orthoptera of northeastern America, with especial reference to the faunas of Indiana and Florida. Nature Publ. Co., Indianapolis. 784 pp. Bibl., pp. 747-767.—Suppl. article in Jour. N. Y. Ent. Soc. 32:127-132. 1924. [Ill. records are included.]

1926 Heteroptera or true bugs of eastern North America, with especial reference to the faunas of Indiana and Florida. Nature Publ. Co. Indianapolis. 1116 pp. Bibl. pp. 1088-1110.—Suppl. notes, 1928, in Jour. N. Y. Ent. Soc. 36:1-23.

1930 . . . A list of the published writings of W. S. Blatchley . . . Nature Publ. Co., Indianapolis. 77 pp.

BLATCHLEY, W. S., AND DANIELS, L. E.

1903 On some Mollusca known to occur in Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 27:577-628. (1902). [A supplementary paper to Call's catalogue. See CALL, 1900 and DANIELS, 1903.]

BLATCHLEY, W. S., AND LENG, C. W.

1916 Rhyncophora or weevils of northeastern America. Nature Publ. Co., Indianapolis. 682 pp. Bibl., pp. 670-676. [Indiana spp. prominent.]—Suppl. articles in Jour. N. Y. Ent. Soc. as follows:
1920 I. 28:161-178.
1922 II. 30:95-106, 113-127.
1925 III. 33:87-113.
1928 IV. 36:235-262.

BLISS, J. S.

1865 On buried stems and branches in Illinois. Am. Jour. Sci. 2d. ser., 39:95-96.

[BOARD OF FOREST PRESERVE COMMISSIONERS OF COOK COUNTY]

1921 The forest preserves of Cook County, Illinois. Publ. by the board, Chicago. 223 pp., maps.

BODE, IRWIN T.

1921 The relation of the smaller areas in non-forested regions to evaporation and movement of soil water. Proc. Iowa Acad. Sci. 27: 137-157. (1920). [4 sites in Backbone State Park, n.w. Delaware co., Iowa.]

BOGGESS, ARTHUR C.

1908 The settlement of Illinois, 1779-1830. Chicago Historical Society. 267 pp.

BOGUSCH, E. R., AND MOLBY, ETHEL E.

1931 Grasses of Champaign county, Illinois. Ill. State Acad. Sci. 23: 104-116. (1930).

BOURNE, A.

1820 On the prairies and barrens of the West. Am. Jour. Sci. and Arts 2:30-34.

BOWERS, J. O., TAYLOR, A. G., AND WOODS, S. B. (Editors)

1929 History of Lake county [Ind.] Vol. 10. Publ. by Lake Co. Histor. Assoc. Gary. 223 pp. [Incl. History of Lake co., 1833-1847, by SOLON ROBINSON, pp. 35-64. Descr. of topogr. and veg., pp. 60-62.]

BRADFIELD, WESLEY

1908 Typical forest regions in Illinois. MSS. U. S. Forest Service, Washington, D. C.

BRADFORD, RALPH F.

1932 A few remarks on conservation in the Illinois River valley. Trans. Ill. State Acad. Sci. 24:587-591. (1931).

BRADLEY, S. RAY

1932 Forest distribution in Crawford County, Illinois. M. A. thesis, Univ. of Ill. 29 pp., 4 maps.

BREESE, SIDNEY

1884 Early history of Illinois, 1673-1763. Chicago, E. B. Myers & Co. 422 pp.

BRENDEL, EMIL

1887 Catalogue of Coleoptera collected in the vicinity of Peoria. Bull. Sci. Assoc. Peoria 1887:53-63.

BRENDEL, FREDERICK

1859 Additions and annotations to Mr. Lapham's catalogue of Illinois plants. Trans. Ill. State Agr. Soc. 3:583-585. (1857-8). [Includes 27 moss spp. from near Peoria.]

1859 The trees and shrubs in Illinois. Trans. Ill. State Agr. Soc. 3:588-604. (1857-58). [Brendel's contribution to prairie-forest problem, p. 589: "On the table land the grasses have preoccupied the soil, and their fibrous and manifold intricated roots, their tufted growth, prevent the seeds of trees, when transplanted by the wind, to germinate and take root."—Rare occurrence of Pinus Banksiana in Ogle Co., fide Bebb.] Continuation in 4:405-413, plates on pp. 416-435. (1859-60). 1861.

1859 The oaks of Illinois. Trans. Ill. State Agr. Soc. 3:605-631, incl. 10 pls. (1857-8). [Botanical characters, life-history, buds, bark, wood, etc. No distributional or habitat data.]

1859 Forests and trees. Trans. Ill. State Agr. Soc. 3:651-661. (1857-8). [Discusses succession, quoting Vaupell and Dureau de la Malle. Includes some facts of Ill. plant geography.—Presented at first meeting of the Ill. Nat. Hist. Soc., at Bloomington, June 30, 1858. (Organization described pp. 637-643.)]

1859 On meteorology in connection with botanical investigations. Trans. Ill. State Agr. Soc. 3:671-675. (1857-8). [Read at 1859 mtg., Ill. Nat. Hist. Soc., Bloomington.—Correlates growth of corn in 1857 with temp. Mentions need for records of soil temp., intensity of insolation, and other data.]

1860 Notices and additions to Illinois flora. Prairie Farmer 22: (new ser. 6:) 294-295. [Lists of plants, mostly from s. Ill.]

1870 Occurrence of rare plants in Illinois. Am. Nat. 4:374.

1887 Flora Peoriana. The vegetation in the climate of middle Illinois. Peoria, J. W. Franks and Sons. 89 pp. [Classic vegetation study and flora.]

1887 Immigration of animals and plants. Bull. Sci. Assoc. Peoria 1887:88-92.

BRETZ, J. HARLAN

1923 Geology and mineral resources of the Kings quadrangle. Ill. State Geol. Surv. Bull. no. 43C. 99 pp. (43:205-304).

BRIGGS, S. A.

1872 The Diatomaceae of Lake Michigan. The Lens 1:41-44.

BROADHEAD, G. C.

1875 [Topography, soil, timber, and prairie in south-central Illinois.] In WORTHEN, rept. on Geol. Surv. Ill., 6:129-130 (Bond co.); 135-137 (Fayette co.—"we ascend by white oak slopes to post oak flats, thence to flat prairies, around which there is generally a margin of pin oak and sometimes black jack and post oak"); 149-150 (Montgomery); 156-158 (Christian, with note on Silphium terebinthinaceum); 163-165 (Shelby); 175-176 (Effingham); 184 (Moultrie, Macon and Piatt counties). [The descriptions of re-

BROADHEAD, G. C.—*Continued*

lation of topography to forest and prairie types are specific and accurate. On the whole they are the same as may be discerned in 1934. He names grasses rarely, but more conspicuous prairie plants frequently. He names many tree species, and uses them as indicators of soil quality. On p. 184 he describes "scalds"—today known as "slick spots" of poor soil, and mentions Ambrosia bidentata as characteristic of them.]

BROWN, AGNES, RUTH MARSHALL, AND PAUL B. RIIS.

1914 The trees of Rockford and vicinity, 11 pp.

1916 Shrubs and vines of Rockford and vicinity, 23 pp. Both publ. by Nature Study Soc. of Rockford, Ill.

BROWN, PERCY EDGAR

1914 The fertility in Iowa soils. Iowa Agr. Exp. Sta. Bull. 1914-15:85-152. (Bull. no. 150). [1905 map of principal soil areas on p. 98.]

BROWN, S. R.

1817 Western gazetteer; or, Emigrant's directory, containing a description of the western states and territories . . . Kentucky, Indiana, Ohio, and the territories of Illinois and Missouri. Auburn, N. Y. 336 pp.

BRUMFIEL, D. M.

1919 The animal ecology of Johnson county [Iowa]. Univ. Iowa Lab. Nat. Hist. Bull. 8 (1):1-37.

BRUNCKEN, ERNEST

1900 Bibliographical notes on Wisconsin forests. Bull. Wis. Nat. Hist. Soc. 1:127-128.

1910 Studies in plant distribution. 9. The shore of Lake Michigan. Bull. Wis. Nat. Hist. Soc. 8:145-157. [Nos. 1 to 8 of this series in vol. 2 of the same publication, deal with Wisconsin floras and vegetation, largely in the vicinity of Milwaukee and Waukesha county. Nos. 1 and 2 are in 2:17-24. 1902. Nos. 2 to 8, 2:137-169. Similar short articles are in vol. 1, 1900.]

BUCK, SOLON J.

1914 Travel and description, 1765-1865, together with a list of county histories, atlases, and biographical collections and a list of territorial and state laws. Springfield, Collections Ill. State Hist. Libr. vol. 9. 514 pp.

1917 Illinois in 1818. Ill. Centennial Publs. Introductory vol., preliminary to the Centenn. History of Ill. Decatur, Ill., Review Printing and Stationery Co. 26 + 362 pp. See ALVORD, C. W., 1920, and PEASE, T. C., 1919.

BUHL, CARL A.

1934 Supplement to an annotated flora of the Chicago area by H. S. PEPOON. Bull. Chicago Acad. Sci. 5:5-12. (See PEPOON, 1927). [Many spp. added, some deleted.]

BURKE, MYRLE

1929 Prairie vegetation and environmental factors. Proc. Iowa Acad. Sci. 35:143-145. (1928). [Black Hawk co.]

1932 Flowering plants of Black Hawk county, Iowa. Proc. Iowa Acad. Sci. 38:135-149. (1931).

BURRILL, A. C.

1910 How sanguinary ants change at will the direction of column in their forays. (F[ormica] sanguinea var.). Bull. Wis. Nat. Hist. Soc. 8:123-131.

1926 Missouri. Pp. 485-490 of Naturalist's guide to the Americas. See SHELFORD, 1926.

1934 Missouri's natural resources, including a source list of where to obtain information . . . Mo. State Museum, Bull. no. 2. 16 pp., mimeographed. Jefferson City. [Arranged under 5 geographic provinces.]

1934 Missouri cave remains . . . Mo. State Museum, Bull. no. 3. 20 pp., mimeographed. Jefferson City. [Gen. account of Mo. caves, with locations and descriptions.]

BURRILL, A. C., AND SMITH, M. R.

1919 A key to the species of Wisconsin ants, with notes on their habits. Ohio Jour. Sci. 19:279-292. See also SMITH, M. R., and BURRILL, A. C.

BURRILL, T. J.

For bibl. of scientific writings of T. J. B., see JANVRIN, 1917.

1879 Effects of frost on plants. Trans. Ill. State Hort. Soc., n. s. 12:155-163. (1878).

1880 Anthrax of fruit trees; or, The so-called fire blight of pear and twig blight of apple trees. Proc. Am. Assoc. Adv. Sci. 1880:583. [First announcement that bacteria cause plant disease.]

1881 Bacteria as a cause of disease in plants. Am. Nat. 15:527-531. [Peach yellows considered due to bacteria, as well as pear blight. Pear blight experiments described. Diseases of Lombardy poplar and aspen also ascribed to bacteria.]

1885 The Uredineae of Illinois—a list of the species. Proc. Am. Micros. Soc. 8:93-96.

1886 The forest-tree plantation [U. of I. campus]. Univ. of Ill. Bd. of Trustees Rept., 13:255-282.

1886 Climatical destruction of orchard trees. Rept. Ill. Industr. Univ. 13:283-293.

1886 Roots of plants. Trans. Ill. State Hort. Soc., n. s. 20:138-149.

1887 Drouth and trees. Trans. Ill. State Hort. Soc., n. s. 21:110-117.

1887 The Erysipheae [mildews] of Illinois. Proc. Am. Micros. Soc. 9:301-310.

1888 The Ustilagineae, or smuts; with a list of Illinois species. Proc. Am. Micros. Soc. 10:45-57.

1888 The forest-tree plantation of the University of Illinois. Garden and Forest 1:465-466.

1889 The biology of silage. Ill. Agr. Exp. Sta., Bull. no. 7: 177-194.

1895 The distribution of plants. Trans. Ill. State Hort. Soc., n. s. 29:105-111.

1897 The tulip tree. Trans. Ill. State Hort. Soc., n. s. 31:436-446.

1902 Report of the University of Illinois. (Report of stream examinations, chemic and bacteriologic, of the waters between Lake Michigan at Chicago and the Mississippi River at St. Louis. . . . Publ. by authority of the trustees of the Sanitary District of Chicago. pp. 97-119.

BURRILL, T. J.—*Continued*

1904 River pollution and purification. Trans. Am. Micros. Soc. 25:105-120.

1904 Micro-organisms of soil and human welfare. Science 20:426-434. Also in Trans. Am. Micros. Soc. 26:5-18.

1907 Forestry for Illinois. Trans. Ill. State Hort. Soc., n. s. 41:62-75.

1908 Report on forestry. Trans. Ill. State Hort. Soc., n. s. 42:91-96.

1911 Flowers and unwelcome guests. Trans. Ill. State Hort. Soc., n. s. 45:318-322.

1913 The drouth and its lessons. Trans. Ill. State Hort. Soc., n. s. 47:79-87.

1914 Summer drouth again. Trans. Ill. State Hort. Soc., n. s. 48:109-117.

BURRILL, T. J., AND McCLUER, G. F.

1893 The forest tree plantation. Bull. Univ. of Ill. Agr. Exp. Sta. 2:205-244. (Bull. 26.)

BURROUGHS, W. G.

1924 The geography of the western Kentucky coal field. Ky. Geol. Surv., ser. 6, vol. 24. 211 pp. [veg., 48-50.]

BURUNJIK, MAY

1931 Studies on germination of seeds of native herbaceous plants of the Chicago region. Trans. Ill. State Acad. Sci. 23:126-127. (1930).

BUSH, B. F.

1895 A list of the trees, shrubs and vines of Missouri. Jefferson City, Mo. Mo. State Hort. Rept. 1895:353-393.

BUSWELL, A. M.

1927 Pollution of streams in Illinois. Ill. State Water Surv. Bull. No. 24. 33 pp. 21 pls.

BUTLER, AMOS W.

1894 Bibliography of Indiana ornithology and notes on Indiana birds. Proc. Ind. Acad. Sci. 1893:108-120.

1896 Indiana—a century of changes in the aspects of Nature. Proc. Ind. Acad. Sci. 1895:31-42.

1898 The birds of Indiana. A descriptive catalogue . . ., with an account of their habits. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 22:515-1187. (1897). [Peculiarities affecting bird distr., p. 524-. Migration, p. 528-. Bibl., pp. 532-548. Full annotations on particular bird spp. in body of text. Index, pp. 1182-1187.]

BUTTS, CHARLES

1925 Geology and mineral resources of the Equality-Shawneetown area. Ill. State Geol. Surv. Bull. no. 47. 76 pp.

BUZZARD, R. G.

1931 The red-top production of southeastern Illinois. Trans. Ill. State Acad. Sci. 23:465-475. (1930). [Red-top and broom-corn are highly localized Ill. crops. The environmental basis for broom-corn is said to be the soil, of quite heavy texture. The center is Arcola, Douglas county.—A. G. V.]

CABLE, E. J.

1917 Bibliography of the loess. Proc. Iowa Acad. Sci. 23:159-162.

CADY, G. H.

1919 Geology and mineral resources of LaSalle and Hennepin quadrangles. Ill. State Geol. Surv. Bull. no. 37. 136 pp.

1927 The areal geology of Saline county. Trans. Ill. State Acad. Sci. 19:250-272. (1926). Maps, block diagram.

CAHN, A. R., AND KEMP, J. T.

1930 The terrestrial mollusks of Turkey Run State Park, Indiana. Trans. Ill. State Acad. Sci. 22:250-262. (1929).

CAIN, S. A.

1932 Studies of virgin hardwood forest: I—Density and frequency of the woody plants of Donaldson's woods, Lawrence county, Indiana. Proc. Ind. Acad. Sci. 41:105-122.

CALKINS, W. W.

1874 Notes on fresh-water Mollusca found in the vicinity of Chicago. Cincinnati Jour. Sci. 1:242-244.

1874 The land and fresh water shells of LaSalle county, Ill. Proc. Ottawa Acad. Nat. Sciences, 1874:1-48. (Chicago, H. McAllaster & Co., Printers.) [Academy of Ottawa, Illinois.]

1896 The lichen flora of Chicago and vicinity. Chicago Acad. Sci., Geol. and Nat. Hist. Surv., Bull. no. 1. 50 pp.

CALL, RICHARD E.

1900 A descriptive illustrated catalogue of the Mollusca of Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 24:335-535, and 78 plates. (1899). [Pl. 1, Hydrographic map of Ind.—See supplementary papers by BLATCHLEY and DANIELS, 1903, and DANIELS, 1903.]

CALVIN, SAMUEL

1911 Aftonian mammalian fauna. Bull. Geol. Soc. Am. 22:207-216.

CALVIN, SAMUEL, AND BAIN, H. F.

1900 Geology of Dubuque county. Iowa Geol. Surv., Ann. Rept. 10:379-622.

CAMERON, J. E.

1897 Forest trees of Delaware county. Repts. Iowa Geol. Surv. 8:193-199.

CAMPBELL, J. L.

1882 Report upon the improvement of the Kankakee River and the drainage of the marsh lands in Indiana. [Referred to, and in part summarized, in BLATCHLEY, 1898:60-65. (Geol. of Lake and Porter counties, q. v.)]

CAMPBELL, JOHN T.

1885 Why certain kinds of timber prevail in certain localities. Am. Nat. 19:337-341. [Infl. of time of shedding seeds of trees in Wabash bottoms, w. Ind.]

1885 Age of forest trees. Am. Nat. 19:838-844. [Growth-ring studies; infl. of tornadoes; resistance of sycamore to burial by flood sediment.]

CAMPBELL, JOHN T.—*Continued*

1886 Track of a cyclone which passed over western Indiana more than three hundred years ago. Am. Nat. 20:348-353.

1886 Causes of forest rotation. Am. Nat. 20:521-527, 851-856. [Crows as carriers of heavy seeds and fruits.]

CAMPBELL, R. A., AND WALLING, H. F.

1870 Campbell's new atlas of the state of Illinois, with descriptions historical, scientific, and statistical. Chicago. R. A. Campbell. Pp. 51-86, incl. maps.

CAREY, JOSEPH P.

1917 The central Illinois tornado of May 26, 1917. Geogr. Rev. 4:122-130. [Incl. photographs of broken trees.]

CARMAN, J. ERNEST

1909 The Mississippi valley between Savanna and Davenport. Ill. State Geol. Surv. Bull. no. 13. 96 pp.

1917 The Pleistocene geology of northeastern Iowa. Ann. Rept. Iowa Geol. Surv. 26:233-445. (1915).

CASE, H. C. M., AND MYERS, K. H.

1934 Types of farming in Illinois. An analysis of differences by areas. Univ. Ill. Agr. Exp. Sta. Bull. 29:95-226. (No. 403). [Agricultural geography: 9 farming-type areas, determined largely by topography, drainage, soil, climate. Maps.]

CHAMBERLIN, T. C., AND SALISBURY, R. D.

1885 The driftless area of the upper Mississippi. U. S. Geol. Surv. Ann. Rept. 6:199-322.

CHANDLER, JOSEPHINE C.

1928 The wild flowers of Illinois and their preservation. Trans. Ill. State Historical Soc. 1927:132-143. Publ. no. 34.

CHANDLER, STEWART C.

1920, 1921 A study of the malarial mosquitoes of southern Illinois. Ill. State Nat. Hist. Surv. Bull. 13:307-328; 14:23-32.

CHAPMAN, HERMAN H., AND MILLER, R. B.

1924 Second report on a forest survey of Illinois. Ill. State Nat. Hist. Surv. Bull. 15:46-172.

CHAPMAN, W. H.

1887 Geology of Peoria county. Bull. Sci. Assoc. Peoria 1887:14-27.

CHASE, VIRGINIUS H.

1932 Frederick Brendel, the pioneer botanist of Peoria. Trans. Ill. State Acad. Sci. 24:72-79. (1931).

CHECK-LIST COMMITTEE, ENGELMANN BOTANICAL CLUB

1911 A preliminary check list of the cryptogams and phanerogams in the vicinity of St. Louis, Missouri. St. Louis. 63 pp.

CHENEY, L. S., AND TRUE, R. H.

1893 On the flora of Madison and vicinity, a preliminary paper on the flora of Dane county, Wisconsin. Trans. Wis. Acad. Sci., Arts, and Letters 9:45-135, with large base map. [900 spp. listed, incl. bryophytes. Brief notes on habitat and abundance.]

CHENOWETH, HOMER E.

1917 The reaction of certain moist forest mammals to air conditions and its bearing on problems of mammalian distribution. Biol. Bull. 32:183-201. [1 species of Peromyscus.]

CHIPERFIELD, B. M., AND HEILBRON, E. H.

1911 Report of the submerged and shore lands legislative investigating committee. Publ. under direction of House of Reprs., State of Ill., Springfield. 3 vols.: 191, 278, and 119 pp., with many plates and maps. [Includes descriptions of streams, lakes, etc.]

CHURCH, HARRY VICTOR

1925 Illinois; history—geography—government. Boston. 342 pp.

CLARK, H. WALTON

1918 Dwarf shore floras [along the Mississippi at Fairport, Iowa]. Trans. Ill. [State] Acad. Sci. 10:145-159. (1917).

CLARK, O. R.

1927 An ecological comparison of two types of woodland (a preliminary report.) Proc. Iowa Sci. Acad. 33:131-134. (1926). [Bur oak-black oak and red oak-linden types, near Cedar Falls.]

CLINTON, G. P.

1894 Observations and experiments on Saprolegnia infesting fish. Bull. U. S. Fish. Comm. 13:163-172. Bibl. pp. 171-172. (1893). (Doc. 253).

CLUTE, WILLARD N.

1911 The flora of the Chicago plain. Am. Bot. 17:65-70.

1912 The summer flora of the Chicago plain. Am. Bot. 18:97-100.

1913 The origin of the Plum Island flora. Am. Bot. 19:41-44. [A forest "island" south of Chicago in the lake-plain prairie.]

1915 Heaths and heath plants. Am. Bot. 21:121-125.

1920 The rarest American plant. Am. Bot. 26:127-129. [Sphaeralcea remota or S. acerifolia.]

1932 Swamp and dune [veg. of dunes, swampy flats, and nearby prairies in n. Ill.] Publ. by the author, Indianapolis. 90 pp.

COCHRANE, JOSEPH

1876 Centennial history of Mason county, including a sketch of the early history of Illinois, its physical peculiarities, soils, climate, productions, etc. Springfield. 352 pp.

COKER, ROBERT E.

1921 The fisheries biological station at Fairport, Iowa. U. S. Bur. Fish. Doc. no. 895. 12 pp.

1929 Keokuk dam and the fisheries of the upper Mississippi River. Bull. U. S. Bur. Fish. 45:85-139. (Doc. no. 1063). (Vol. issued 1930). [Infl. of the dam as a barrier, as modifying environment above it, and of flooding. Figs. 16 and 17 show drowning of trees.]

1930 Studies of common fishes of the Mississippi River at Keokuk. Bull. U. S. Bur. Fish. 45:141-225. (Doc. no. 1072). [Life-history and ecology.]

COKER, R. E., SHIRA, A. F., CLARK, H. W., AND HOWARD, A. D.

1921 The natural history and propagation of fresh-water mussels. Bull. U. S. Bur. Fish. 37:75-181, pls. 5-21. Bibl., p. 176. (Doc. 893). (1919-20).

COLLIE, G. L.

1901 Physiography of Wisconsin. Bull. Am. Bur. of Geogr. 2:270-287.

COLLINS, W. D.

1910 The quality of the surface waters of Illinois. U. S. Geol. Surv., Water-Supply Paper 239.

COLYER, FRANK H.

1922 The geography of the [Illinois] Ozarks. Trans. Ill. State Acad. Sci. 14:36-43. (1921).

COMMITTEE ON ECOLOGICAL SURVEY, S. A. FORBES, Chairman.

1910 to 1920 Reports of the Committee on Ecological Survey [of Ill. State Acad. Sci.]

1910	2:5-6 (1909)	1916	8:15-17 (1915)
1911	3:51-56 (1910)	1918	9:14-16 (1916)
1912	4:24-26 (1911)	1918	10:30-34 (1917)
1914	6:18-23 (1913)	1920	11:15-18 (1920)
1916	7:12-16 (1914)		

CONARD, H. S.

1918 Tree growth near Grinnell. J. For. 16:100-106.

1933 Mosses of Pine Hollow, Iowa. Bryologist 35:28-30. (1932).

1933 A boreal moss community. [Pine Hollow, Dubuque co., Iowa.] Proc. Iowa Acad. Sci. 34:57-61. (1932). See PAMMEL, 1924.

CONARD, MEL. T.

1902 The vegetation of abandoned rock quarries. Proc. Ind. Acad. Sci. 1901:266-272.

1905 The insect galls of Indiana. Ind. Dept. Geol. and Nat. Resources. Ann. Rept. 29:801-867. (1904). Bibl., pp. 864-867.

CORY, C. B.

1909 The birds of Illinois and Wisconsin. Field Mus. Nat. Hist., Publ. no. 131, Zool. Ser. vol. 9. 764 pp.

1912 The mammals of Illinois and Wisconsin. Field Mus. Nat. Hist., Publ. no. 153, Zool. Ser. vol. 11. 505 pp. Bibl. on mammals of these two and ajoining states, pp. 483-487. [Many valuable figures and range maps, and observations from accounts by early explorers.]

COULTER, JOHN M.

1876 The "knobs" of southern Indiana. Bot. Bull. 1:41-42. [Agave Virginica and Vaccinium arboreum and other thin-soil xerophytes extend farther north in Indiana than in Illinois.]

1879 The flora of northern Indiana. Bot. Gaz. 4:109-113. [Five divisions: sand hills and plains bordering L. Mich.; wet grassy meadows and swamps, especially s. of Otis and LaPorte; small lakes; tamarack and sphagnous swamps along the Kankakee, near Kendallville; prairie.]

1917 A century of botany in Indiana. Proc. Ind. Acad. Sci. 1916:236-260. [Extensive bibl. of Ind. botany.]

COULTER, J. M. AND M. S. See EDITORS OF THE BOTANICAL GAZETTE

COULTER, SAMUEL M.

1903 An ecological comparison of some typical swamp areas. Rept. Mo. Bot. Gard. 15:38-71, 24 pls. [Incl. Lake Calumet district s. of Chicago, and Horseshoe Lake, Alexander co.; also cypress-tupelo swamp of St. Francis River, n.e. Ark.]

COULTER, STANLEY

1892 The forest trees of Indiana, their distribution and economic value. Trans. Ind. Hort. Soc. 1891:157-192.

1899 Notes on the germination and seedlings of certain native plants. Proc. Ind. Acad. Sci. 1898:215-226.

1900 A catalogue of the flowering plants and of the ferns and their allies indigenous to Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 24:553-1002; index 1019-1074. Habitat, abundance, and seasonal notes, county records. Bibl., pp. 597-605. (1899).

1915 Notes on distribution of forest trees in Indiana. Proc. Ind. Acad. Sci. 1914:167-177.

COWLES, HENRY CHANDLER

1899 The ecological relations of the vegetation on the sand dunes of Lake Michigan. Bot. Gaz. 27:95-117, 167-202, 281-308, 361-391.

1901 The physiographic ecology of Chicago and vicinity: a study of the origin, development, and classification of plant societies. Bot. Gaz. 31:73-108; 145-182. Also Geogr. Soc. of Chicago, Bull. No. 2, 76 pp.

1901 The influence of underlying rocks on the character of the vegetation. Bull. Am. Bur. of Geogr. 2: (Reprinted from June and Dec. nos., pp. numbered 1-26).

1903 Contrasts and resemblances between the sand dune floras of Cape Cod and Lake Michigan. Science, n.s. 17:262.

1911 Causes of vegetative cycles. Bot. Gaz. 51:161-183. Also, Causes of vegetational cycles, Ann. Assoc. Am. Geogr. 1:3-20.

1912 A fifteen-year study of advancing sand dunes. Rept. Brit. Assoc. Adv. Sci. 1911:565.

1913 The International Phytogeographic Excursion (I. P. E.) in America, 1913. Excursion Program: First Section—New York to Lincoln. Univ. of Chicago Press. 16 pp. (Deals mostly with country visited near Chicago).

1928 Persistence of prairies. Ecology 9:380-382. [Due to the differing reactions upon soil of prairie and forest, each tends to persist in its original areas.]

1932 Conservation of Illinois areas of botanical value. Trans. Ill. State Acad. Sci. 24:86-89. (1931).

COWLES, H. C., SMITH, J. L., MILLER, R. B., JENSEN, J., AND SEYMOUR, R. F.

1922 Proposed park areas in the state of Illinois. Publ. by Friends of our Native Landscape, Chicago. 120 pp., maps, figs. (The above-named were the Committee on Publication.) Includes articles on Apple River Canyon (by H. S. PEPOON), White Pines near Oregon (REBECCA KAUFMANN), Starved Rock (H. HULL), and s. Ill. (COWLES).

COX, FLEMIN W.

1924 Pleistocene deposits in Lawrence county. Trans. Ill. State Acad. Sci. 16:347:352. (1923).

1933 Southern Illinois as a focus for primitive people [Indians] because of geographic factors. Trans. Ill. State Acad. Sci. 25:103-105. (1932).

COX, HENRY J. AND ARMINGTON, JOHN H.

1914 The weather and climate of Chicago. Geogr. Soc. of Chicago, Bull. no. 4. Univ. of Chicago Press. 25 + 375 pp.

[CRAM, G. F.]

1906 Cram's superior reference atlas of Illinois and the world. New York, Chicago. G. F. Cram. 158 pp. incl. 61 maps, 17 pls. Folio.

CRANE, J. L., JR., AND OLCOTT, G. W.

1933 Report on the Iowa twenty-five year conservation plan. DesMoines. 176 pp. Maps, bibl.

CRATTY, R. I.

1898 The Iowa sedges. Bull. Lab. Nat. Hist. Univ. Iowa 4:313-375, with 10 pls.

1922 Dr. Rudolph Gmelin and his collection of Minnesota, Wisconsin and Iowa plants. Proc. Iowa Acad. Sci. 28:246-255. (1921). [List of the plants, many from vicinity of Elkader and Guttenberg. Iowa, not far from Dubuque.]

1925 Iowa plant notes. Proc. Iowa Acad. Sci.
to I. 31:189-192. (1924).
1933 II. 33:125-128. (1926).
III. 35:105-109. (1928).
IV. 37: 87- 90. (1930).
V. 39: 85- 88. (1932).

CRESSEY, GEORGE B.

1928 The Indiana sand dunes and shore lines of the Lake Michigan Basin. Geogr. Soc. of Chicago. (Univ. of Chicago Press). 77 pp.

CROOK, A. R.

1907 A history of the Illinois State Museum of Natural History, Springfield. 21 pp. [Information on life, work and writings of J. G. Norwood, A. H. Worthen, and later curators of the museum.]

CROXTON, W. C.

1928 Revegetation of Illinois coal-stripped lands. Ecology 9:155-175.

CULVER, H. E.

1922 Geology and mineral resources of the Morris quadrangle. Ill. Geol. Surv. Bull. no. 43B. 109 pp. (43:95-204. 1923).

CUNNINGHAM, ALIDA M.

1898 The Ericaceae of Indiana. Proc. Ind. Acad. Sci. 1897:166-168.

CUNNINGHAM, J. C.

1913 Roots and root-stocks of weeds. Bull. Iowa Geol. Surv. 4:641-654.—Revised ed. 4:540-550. 1926.

CUTLER, JERVIS

1812 Topographical description of the state of Ohio, Indiana territory, and Louisiana, comprehending the Ohio and Mississippi rivers and their principal tributary streams. Boston. 219 pp.

DANA, E.

1819 Geographical sketches of the western country, designed for emigrants and settlers . . . Cincinnati. 312 pp.

DANGLADE, ERNEST

1914 The mussel resources of the Illinois River. Ann. Rept. U. S. Commr. of Fisheries, 1913, Appendix 6. 28 pp. (1st part of Doc. 804).

DANIELS, L. E.

1903 A check-list of Indiana mollusca, with localities. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 27:629-652. (1902). [See CALL, 1900, and BLATCHLEY and DANIELS, 1903.]

1915 A supplemental check list of Indiana mollusca, with localities and notes. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 39:318-326. (1914).

DARLING, FRANK W.

1904 . . . Illinois. Suppl. vol. to Tarr and McMurry geographies. 77 pp., incl. maps.

DARLINGTON, HENRY T.

1923 The introduced weed flora of Illinois. Trans. Ill. State Acad. Sci. 15:171-184. [Extensive bibl. of Ill. bot.]

DAUBENMIRE, REXFORD F.

1929 The relation of certain ecological factors to the inhibition of forest floor herbs under hemlock. Butler Univ. Bot. Studies 1:61-76 (1929-30). [At Turkey Run State Park, Parke co., Ind.]

1930 Some flowering plants collected in Parke County, Indiana. Proc. Ind. Acad. Sci. 39:133-134. (1929).

1931 Additions to the vascular flora of Parke County, Indiana. Proc. Ind. Acad. Sci. 40:75-76. (1930).

DAVIDSON, ALEXANDER, AND STUVÉ, BERNARD

1874 A complete history of Illinois, 1673-1763. Springfield, Ill. Journal Co. 944 pp.

DAVIDSON, VERA SMITH

1932 The effect of seasonal variation upon animal species in total populations in a deciduous forest succession. Ecol. Mon. 2:305-334.

DAVIS, DARRELL H.

1923 The geography of the Jackson Purchase [gulf embayment, w. end of Ky.] Ky. Geol. Surv., Ser. 6, vol. 9. 185 pp. [Veg. animals, 54-60.]

DAVIS, JOHN J.

1919 Contributions to a knowledge of the natural enemies of Phyllophaga. Ill. State Nat. Hist. Surv. Bull. 13:53-138.

DAVIS, N. S., JR., AND RICE, F. L.

1883 List of Batrachia and Reptilia of Illinois. Bull. Chicago Acad. Sci. 1:25-32.

DAVIS, WILLIAM MORRIS

1894 The ancient outlet of Lake Michigan. Pop. Sci. Mo. 46:218-229.

DAY, P. C.

1926 Precipitation of the drainage area of the Great Lakes. Mo. Weath. Rev. 54:85-106.

DAY, RALPH K., AND DEN UYL, DANIEL

1932 The natural regeneration of farm woods following the exclusion of livestock. Purdue Univ. Agr. Exp. Sta. Bull. no. 368. 48 pp. [Tight sod established by grazing effectively prevents the material establishment of any tree spp.]

DEAM, C. C.

1912 Additions to the flora of the lower Wabash valley, by Dr. J. Schneck. Proc. Ind. Acad. Sci. 1911:365-369.

1924 Shrubs of Indiana. Ind. Dept. of Conservation. Publ. no. 44. Indianapolis. 351 pp.

1929 Grasses of Indiana. Ind. Dept. of Conservation. Publ. no. 82. Indianapolis. 356 pp.—Additions by J. E. POTZGER in Proc. Ind. Acad. Sci. 42:93-95. 1933.

1932 Trees of Indiana, 4th ed. (2d revised). Ind. Dept. of Conservation. Publ. no. 13. Fort Wayne. 326 pp. Maps showing distribution by counties.

DEANE, RUTHVEN

1895 Additional notes on the passenger pigeon in Illinois and Indiana. The Auk 12:98.—See also pp. 298 and 300; also p. 80.

DEAY, HOWARD O.

1933 The Cicadellinae of Indiana (Cicadellidae, Homoptera). Proc. Ind. Acad. Sci. 42:227-241.

DE FOREST, H.

1922 The plant ecology of the Rock River woodlands of Ogle county, Illinois. Trans. Ill. State Acad. Sci. 14:152-193. (1921).

DEN UYL, D., AND DAY, R. K.

1934 Woodland carrying capacities and grazing injury studies. Purdue Univ. Agr. Exp. Sta. Bull. no. 391. 12 pp. [Growing timber and pasturing live-stock on same area are incompatible aims and should not be attempted.]

DICKEN, S. N.

1930 Kentucky karst landscapes. Abstract. Ann. Assoc. Am. Geogr. 20:27-28. [Stages in physiographic development.]

DICKINSON, W. E.

1932 The crane-flies of Wisconsin . . . Bull. Publ. Mus. Milwaukee 8:139-266. Bibl. pp. 243-246.

DICKSON, J. G., AND HOLBERT, J. R.

1928 The relation of temperature to the development of disease in plants. Am. Nat. 62:311-333.

DIETZ, HARRY F.

1921 Notes on the termites of Indiana—I. Proc. Ind. Acad. Sci. 1920:87-96.
1924 —II. 33:299-301. [Western termite in sandy areas near Wabash R., s. Ind.]

DINWIDDIE, EDWIN W.

1884 The fauna of Lake county. Pp. 150-157 of BALL, 1884, q. v.

DOPP, MARY

1913 Geographical influences in the development of Wisconsin. Bull. Am. Geogr. Soc. 45:401-412, 490-499, 585-609, 653-663, 736-749, 831-846, 902-920.

DOUGLAS, ROBERT

1897 The red cedar. Garden and Forest 10:178-179. [Red cedar and arbor vitae nearly covered lake-shore bluffs near Waukegan in 1844. Red cedar then abundant on banks of inland lakes in Lake county.]

DOWNING, ELLIOTT R.

1922 A naturalist in the Great Lakes region. Univ. Chicago Press. 25 + 328 pp.

DRYER, CHARLES R.

1908 Studies in Indiana geography. Inland Publ. Co., Terre Haute. 114 pp., 10 maps. Earlier eds. 1897, 1906. Incl. articles on glacial deposits by F. LEVERETT and history of Great Lakes by F. B. TAYLOR.

1910 Geographic influences in the development of Indiana. Jour. Geogr. 9:17-22. ". . . the people were thoroughly trained in the principles and practice of anti-forestry."

1911 A physiographic survey of the Terre Haute area—report of progress. Proc. Ind. Acad. Sci. 1910:145-146.

DUNLAP, FREDERICK

1921 Growth of oak in the Ozarks. Univ. Mo. Agr. Exp. Sta., Res. Bull. 41. 28 pp.

DURAND, LOYAL, JR.

1931 [Map of geographic divisions of Wisconsin.] In: Wisconsin dairying. Wis. Crop and Livestock Reporting Serv. Bull. no. 120. [The boundaries are drawn on a relief map. Reproduced in Geogr. Rev. 23:135-136. 1933. Abbreviated names of divisions bordering Ill. are: Southwestern maturely dissected ridge and valley region, Rock county, Southeastern region, and Lake Shore belt.]

EATON, S. H.

1931 The ligneous flora of Lawrence county. Trans. Ill. Acad. Sci. 23:149-159. (1930). [Big Slough bottom: isolated bottom-type forest. Northernmost inland records for Taxodium. Robeson Hills in Wabash bottoms. Allison Prairie, in Wabash valley. King Hill area of forest. Presence of mistletoe in this northerly latitude confirmed.]

EDDY, SAMUEL

1925 Presence of living organisms in lake ice. [Lake Decatur.] Trans. Ill. State Acad. Sci. 17:85-86. (1924).

1925 Freshwater algal succession. Trans. Am. Micr. Soc. 44:138-147. [Small stream near Muncie, Ill.]

1927 A study of algal distribution. Trans. Am. Micr. Soc. 46:122-138. [Habitat-differentiation in Crystal Lake (artificial) at Urbana, Ill.]

1927 Notes on the occurrence of shore birds and waterfowl on a new artificial lake. Wilson Bulletin 39:223-228. [Lake Decatur.]

1927 The plankton of Lake Michigan. Ill. State Nat. Hist. Surv. Bull. 17:203-232.

1928 Growth of diatoms in relation to dissolved gases. Trans. Ill. State Acad. Sci. 20:63-66. (1927).

1932 The plankton of the Sangamon river in the summer of 1929. Ill. Nat. Hist. Surv. Bull. 19:469-486.

EDDY, S. AND SIMER, P. H.

1929 Notes on the food of the paddlefish and the plankton of its habitat. Trans. Ill. State Acad. Sci. 21:59-68. (1928).

EDITORS OF THE BOTANICAL GAZETTE, AND BARNES, C. R.

1881 Catalogue of the phaenogamous and vascular cryptogamous plants of Indiana. Crawfordsville. 38 pp. [A suppl. to Bot. Gaz. See notes, Bot. Gaz. 6:179, 191. 1881.]
Suppl. I to the catalogue, 3 pp., was issued April, 1882. (The editors were John M. Coulter and M. S. Coulter).

EDWARDS, GRACE OSBORNE

1898 A select bibliography of the history of Illinois, 1673-1861. B.L.S. Thesis, Univ. Ill. 67 pp.

EGGERT, HENRY

1891 Phaenogamous and vascular cryptogamous plants in the vicinity of St. Louis, Missouri. Publ. by the author, St. Louis. 16 pp. [Nearly 1100 species and varieties.]

EIFRIG, C. W. G.

1913 Notes on some of the rarer birds of the prairie part of the Chicago area. The Auk 30:236.

1919 The birds of the sand dunes of northwestern Indiana. Proc. Ind. Acad. Sci. 1918:289-303.

1919 Notes on birds of the Chicago area and its immediate vicinity. The Auk 36:513-524.

EIGENMANN, CARL H.

1917 The homes of blindfishes. Geogr. Rev. 4:170-182. [Incl. discussion of Ind. and Ky. blindfishes, and (p. 176) mentions an eyed relative, in a cave spring in s. Ill.]

EIGENMANN, C. H., AND BEESON, C. H.

1894 The fishes of Indiana. Proc. Ind. Acad. Sci. 1893:76-108. (Bibl. of Ind. fishes, pp. 71-76.)

EIKENBERRY, W. L.

1913 Notes on the forests of Ogle county, Illinois. Trans. Ill. [State] Acad. Sci. 5:121-125. (1912).

EKBLAW, GEORGE E.

1931 Some evidences of incipient stages of Lake Chicago. Trans. Ill. State Acad. Sci. 23:387-390. (1930). [Pre-Glenwood stage at a level 20 feet higher.]

EKBLAW, G. E., AND ATHY, L. F.

1925 Glacial Kankakee torrent in northeastern Illinois. Bull. Geol. Soc. Am. 36:417-428.

ELDRIDGE, JOHN A.

1914 The mussel fishery of the Fox River. Ann. Rept. U. S. Commr. of Fisheries, 1913, Appendix 7. 8 pp. (2d part of Doc. 804).

ELLSWORTH, WINIFRED

1923 Parry's catalog of Iowa plants of 1848. Proc. Iowa Acad. Sci. 29:339-344. (1922). [Data include habitat, locality or district (for a few spp.), and month of collection.]

ELROD, M. N.

1899 The geologic relations of some St. Louis group caves and sinkholes. Proc. Ind. Acad. Sci. 1898:258-267.

EMERSON, FRED W.

1921 Subterranean organs of bog plants. Bot. Gaz. 72:359-374.

ENGELMANN, GEORGE

1843 Catalogue of a collection of plants made in Illinois and Missouri, by Charles A. Geyer; with critical remarks, etc. Am. Jour. Sci. 46:94-104. Collected works: 506-510.

1861 Difference of temperature and relative humidity in city and country. Trans. Acad. Sci. St. Louis 2:70-74. (Vol. 2, 1861-1868). See also Trans. 1:693, and A. FENDLER, Smithson. Rept. for 1860:403.

1880 Vegetation along the lakes. Trans. St. Louis Acad. Sci. 4; 190-192. [Read in 1878.] on p. 408 of coll. works. [Apparently recognized Hill's oak (before it was described) as different from red oak and black oak.]

1883 The mean and extreme daily temperatures in St. Louis during forty-seven years, as calculated from daily observations. With diagram summarizing results, by G. HAMBACH. Trans. Acad. Sci. St. Louis 4:496-508. (1878-1886).

1887 Collected botanical works. See TRELEASE and GRAY, 1887.

ENGELMANN, HENRY A.

1863 Remarks upon the causes producing the different characters of vegetation known as Prairies, Flats, and Barrens in southern Illinois, with special reference to observations made in Perry and Jackson counties. Am. Jour. Sci. and Arts (ser. 2) 36:384-396. [Emphasizes poor drainage and fine-textured soil of prairie uplands. The flats or post-oak flats, are admirably described: scattered tree growth, with prairie plants between.]

ENGELMANN, HENRY A.—*Continued*

1865 On the fruit soils of Illinois. Trans. Ill. State Agr. Soc. 5:938-947. (1861-'64). Also publ. in Trans. Ill. State Hort. Soc. for 1864:-58-67. 1865. [Of high value for its descriptions of physical geography, soil, and vegetation. 6 divisions distinguished for southwestern Ill.: 1. Prairie soils (poor drainage emphasized). 2. Post-oak flats and barrens (latter mostly on slopes). "Before long the last of the grass-barrens will be naturally changed into forests . . . of black-oak and post-oak." 3. White and black-oak ridges [Ozark hills]. 4. Tertiary formation in the extreme south. 5. Mississippi bluffs. 6. Bottom-lands of the Mississippi.]

1866 [Surface configuration and timber of Pulaski and Massac counties.] Geol. Surv. Ill. (WORTHEN) 1:410-412, 429-434. [These are the more specific notes on timber in 2 of the 5 county descriptions by ENGELMANN in this vol. Good correlations with substratum and topogr.] See also WORTHEN (and ENGELMANN), 1868.

1868 [Surface configuration, prairie, and timber of Washington, Clinton, Marion, and Jefferson counties.] Geol. Surv. Ill. (WORTHEN) 3:146-147, 173-174, 192-193, 219.

ERLANSON, EILEEN W.

1924 A list of plants chiefly from Putnam county, collected 1910-15 by Earl J. Grimes. Proc. Ind. Acad. Sci. 1923:123-163.

EVANS, HARRY A.

1889 The relation of the flora to the geological formation in Lincoln county, Kentucky. Bot. Gaz. 14:310-314. [Herbaceous spp. of treeless growths listed. Cork elm, yellow-wood, and certain herbs correlated with Chazy limestone, etc.]

EVERMANN, BARTON W.

1902 List of species of fishes known to occur in the Great Lakes or their connecting waters. Bull. U. S. Bur. Fish. 21:95-96. (Doc. 486). (1901).

1917 A century of Zoology in Indiana. 1816-1916. Proc. Ind. Acad. Sci. 1916:189-224.

1921 Notes on the birds of Carroll, Monroe, and Vigo counties, Indiana. Proc. Ind. Acad. Sci. 1920:315-401. [Records beginning in 1883 (a few from earlier years). Extensive bibl. of short articles on birds by B. W. E.]

EWER, S. J.

1930 MS catalogue of Illinois vascular plants. Filed with Dept. of Botany, Univ. of Ill.

1932 Life-forms of Illinois plants. Trans. Ill. State Acad. Sci. 24:108-121. (1931).

EWING, H. E.

1909 The Oribatoidea of Illinois. Bull. Ill. State Lab. Nat. Hist. 7:337-389.

1909 A systematic and biological study of the Acarina of Illinois. Univ. Ill. Studies 3 (6):359-472, with 8 pls. The separate is paged 1-118.

FARNHAM, MRS. ELIZA W.

1847 Life in the prairie land. New York. 408 pp.

FENNELL, R. E.

1925 The Polyporaceae of Iowa. Proc. Iowa Acad. Sci. 31:193-204. (1924).

FENNEMAN, N. M.

1909 Physiography of the St. Louis area. Ill. State Geol. Surv. Bull. no. 12. 83 pp.

1910 The lakes of southeastern Wisconsin. Wis. Geol. and Nat. Hist. Surv., Bull. no. 8. 188 pp. 2d ed. issued.

FERNALD, M. L.

1925 Persistence of plants in unglaciated areas of boreal America. Mem. Am. Acad. Arts and Sciences 15 (3):237-342. [Driftless area, p. 317; maps 42-46.]

FIDLAR, MARION M.

1933 Some hills of circumalluviation in the lower Wabash valley. Proc. Ind. Acad. Sci. 42:135-140. [Some of these in Ill., as Robeson Hills near Lawrenceville.]

FINK, BRUCE

1895 Lichens of Iowa. Bull. Lab. Nat. Hist. Univ. Iowa, Part II of vol. 3:70-88.

1895 The lichens of Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa 3:70-88. [196 spp. and varieties.]

1899 Notes on lichen distribution in the upper Mississippi Valley. Mem. Torrey Bot. Club 6:285-307.

1906 Floristic notes from an Illinois esker. Proc. Iowa Acad. Sci. 13:59-63. (1905).

FISHER, D. J.

1925 Geology and mineral resources of the Joliet quadrangle. Ill. State Geol. Surv. Bull. no. 51. 160 pp.

FISHER, F. A.

1934 Our soil erosion menace. Trans. Ill. State Acad. Sci. 27:27-31. [Mention of erosion-control project near Leroy in McLean county, Ill.]

FITZPATRICK, T. J.

1898 Notes on the flora of northeastern Iowa. Proc. Iowa Acad. Sci. 5:107-133. (1897).

1899 Manual of the flowering plants of Iowa. Publ. by the author Lamoni, Iowa. 143 pp.

FITZPATRICK, T. J. AND M. F. L.

1898 Flora of southern Iowa. Proc. Iowa Acad. Sci. 5:134-173. (1897).

1900 The Ranunculaceae of Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 5:87-137, with 3 pls. [Year may be 1899.—Species grouped by habitats, pp. 93-94.]

1901 The native oak groves of Iowa. Plant World 4:69-71.

1902 A study of the island flora of the Mississippi River near Sabula, Iowa. Plant World 5:198-201.

? FLAGG, W. C. (No name with article)

1868 Fruit districts of Illinois. Trans. Ill. State Hort. Soc. 12:(new ser. 1:)222-225. (1867). [Flagg was secretary, and prepared the volume for publication. Several geographic apportionments are discussed, including one having 3 divisions based on latitude. Another proposed in 1860 by C. T. CHASE had 7 districts (Lake Shore, Galena, N. Ill., Bloomington, Alton, Centralia, and Jonesboro). This took soil and climate into consideration. A 5-division arrangement was based by WORTHEN on surface geology. A new proposal, perhaps Flagg's, embraced latitude, temp., rainfall, outcrops, soils, vegetation, kinds of trees, and configuration (topography). The result is 7 districts: Fox River, Rock River, Illinois River, Grand Prairie, Wabash, Kaskaskia, and Grand Chain Districts. A table summarizing the characters of the 7.] CHASE'S division into 7 districts is published in Prairie Farmer 23:70. 1861.

FLAGG, W. C. (with additions by T. J. BURRILL)

1878 Catalogue of the flowering and higher flowerless plants of Illinois, native and introduced. Rept. Ill. Industr. Univ. 9:221-297.

FLINT, RICHARD F.

1931 Glaciation in northwestern Illinois. Am. Jour. Sci. 221:(5th ser. 21:)422-440. [Explains surface features of Driftless Area and areas of Illinoian and Wisconsin drift. Block diagram p. 423.]

FLINT, W. P.

1931 Illinois' changing insect problems. Trans. Ill. State Acad. Sci. 23:236-240. (1930). [Native insects turned to cultivated foodplants, but later were in larger part replaced or overshadowed by introduced insect pests.]

1934 The automobile and prairie wild life. Ill. State Nat. Hist. Sury., Biol. Notes no. 3. 8 pp., mimeographed. [Destruction of animals on highway east of Urbana.]

FLINT, W. P. AND MALLOCH, J. R.

1920 The European corn-borer and some similar native insects. Ill. State Nat. Hist. Surv. Bull. 13:287-305.

FLUKE, C. L.

1929 The known predaceous and parasitic enemies of the pea aphid [Illinoia pisi] in North America. Wis. Agr. Exp. Sta., Res. Bull. no. 93. 47 pp. Extensive bibl.

FOLSOM, J. W.

1909 The insect pests of clover and alfalfa. Bull. Univ. Ill. Agr. Exp. Sta. 9:111-197. (no. 134). [Incl. many insect spp. native to middle west.]

FORBES, STEPHEN A.

1870 Botanical notes [on southern Illinois]. Am. Ent. and Bot. 2:317-318, 352. [Ozark hills, cliffs, rock-barrens, Pine Hills; flowering herbs. See also p. 310, and p. 288 (VASEY): Heuchera, and Saxifraga Forbesii.]

1876 List of Illinois Crustacea, with descriptions of new species. Bull. Ill. State Lab. Nat. Hist. 1 (1 and 2):3-25.

FORBES, STEPHEN A.—*Continued*

1878 On the Crustacea eaten by fishes. Bull. Ill. State Lab. Nat. Hist. 1 (2):87-89.

1878 The food of Illinois fishes. Bull. Ill. State Lab. Nat. Hist. 1 (2):71-86.

1880 On the food of young fishes. Bull. Ill. State Lab. Nat. Hist. 1 (3):71-85. 2d ed. 1903.

1880 The food of birds [the thrush family and the bluebird]. Bull. Ill. State Lab. Nat. Hist. 1 (3):86-161. 2d ed. 1903.

1880 On some interactions of organisms. Bull. Ill. State Lab. Nat. Hist. 1 (3):3-18. 2d ed. 1903.

1880 Notes on insectivorous Coleoptera. Bull. Ill. State Lab. Nat. Hist. 1 (3):167-176. 2d ed. 1903.

1880 The food of fishes [Acanthopteri]. Bull. Ill. State Lab. Nat. Hist. 1 (3):19-70.

1880 The food of the darters. Am. Nat. 14:693-703.

1882 On the lakes of Illinois. Ill. School Jour. 2: No. 1, pp. 17-18; No. 2, 14-15.

1882 On some entomostraca of Lake Michigan and adjacent waters. Am. Nat. 16:537-542; 640-649.

1883 The regulative action of birds upon insect oscillations. Bull. Ill. State Lab. Nat. Hist. 1 (6):3-32. Reprinted.

1883 The food relations of the Carabidae and Coccinellidae. Bull. Ill. State Lab. Nat. Hist. 1 (6):33-64. Reprinted 1912:33-60.

1883 The food of the smaller fresh-water fishes. Bull. Ill. State Lab. Nat. Hist. 1 (6):65-94. Reprinted 1912:61-86.

1883 The first food of the common white fish. Bull. Ill. State Lab. Nat. Hist. 1 (6):95-109. Reprinted 1912:87-99.

1883 Food relations of predaceous beetles. In 12th rept. Ill. State Entomologist, pp. 105-120.

1885 On some insect enemies of the soft maple; insects injurious to the elm. In 14th rept. Ill. State Entomologist, pp. 103-111; 112-115.

1887 The lake as a microcosm. Bull. Sci. Assoc. Peoria, 1887:77-87. Reprinted with emendations in Ill. State Nat. Hist. Surv. Bull. 15:537-550. 1925.

1887 The relations of ants and aphids. Am. Nat. 21:579-580.

1888 Studies of the food of fresh-water fishes. Bull. Ill. State Lab. Nat. Hist. 2:433-473.

1888 On the food relations of fresh-water fishes: A summary and discussion. Bull. Ill. State Lab. Nat. Hist. 2:475-538.

1890 The meadow maggots, or leather jackets [Tipulid larvae]. In 16th rept. Ill. State Entomologist, pp. 78-83.

1890 Economic bibliography of the chinch bug, 1785-1888. Appendix to 16th rept. Ill. State Entomologist, pp. 1-122.

1890 Preliminary report upon the invertebrate animals inhabiting Lakes Geneva and Mendota, Wisconsin, with an account of the fish epidemic in Lake Mendota in 1884. Bull. U. S. Bur. Fish. 8:473-487. (Doc. 147, 1891).

1891 On the common white grubs. In 17th rept. State Entomologist, pp. 30-53.

FORBES, STEPHEN A.—*Continued*

1892 Bacteria normal to digestive organs of Hemiptera. Bull. Ill. State Lab. Nat. Hist. 4:1-7.

1895 A monograph of insect injuries to Indian corn—Part I. 18th rept. Ill. State Entomologist, 171 + pp., 15 pls. 2d ed. 1920.

1905 Part II. The more important insect injuries to Indian corn. 23d rept., 280 pp. 2d ed. 1920.

1905 Illinois River plankton. Science 21:233-234.

1907 On the local distribution of certain Illinois fishes: An essay in statistical ecology. Bull. Ill. State Lab. Nat. Hist. 7:273-303.

1907 An ornithological cross-section of Illinois in autumn. Bull. Ill. State Lab. Nat. Hist., 7:305-335. 2d ed. 1914.

1907 On the life-history, habits, and economic relations of the white-grubs and May-beetles. Bull. Ill. Agr. Exp. Sta. 7:445-480. (No. 116.)

1908 Habits and behavior of the corn-field ant, Lasius niger americanus. Bull. Ill. Agr. Exp. Sta. 8:31-45. (No. 131.)

1909 History of the former state natural history societies of Illinois. Trans. Ill. State Acad. Sci. 1:18-30. (1908.)

1909 On the general and interior distribution of Illinois fishes. Bull. Ill. State Lab. Nat. Hist. 8:381-437.

1909 The general entomological ecology of the Indian corn plant. Am. Nat. 43:286-301. Reprinted 1927, Ill. State Nat. Hist. Surv. Bull. 16:447-457.

1910 Biological investigations on the Illinois River. Ill. State Lab. Nat. Hist., Urbana. 14 pp.

1911 Some important insects of Illinois shade trees and shrubs. Bull. Ill. Agr. Exp. Sta. 10:461-529. (No. 151.)

1913 The native animal resources of the state. Trans. Ill. Acad. Sci. 5:37-48. (1912.)

1913 The midsummer bird life of Illinois: A statistical study. Bull. Ill. State Lab. Nat. Hist. 9:373-385.

1914 Freshwater fishes and their ecology. Ill. State Lab. Nat. Hist., Urbana. 19 pp., 10 pls., 21 maps.

1915 The ecological foundations of applied entomology. Ann. Ent. Soc. Am. 8:1-19.

1916 A general survey of the May-beetles (*Phyllophaga*) of Illinois. 29th rept. Ill. State Entomologist, pp. 23-70. Also, Bull. Ill. Agr. Exp. Sta. 13:213-257 (No. 186).

1916 The influence of trees and crops on injuries by white grubs. Bull. Ill. Agr. Exp. Sta. 13:259-265 (No. 187).

1919 Recent forestry survey of Illinois. Trans. Ill. Hort. Soc. 52:103-110.

1922 The humanizing of ecology. Ecology 3:89-92.

1926 The effects of stream pollution on fishes and their food. Reprinted (1928) from Outdoor America, Sept. issue, 1926. 13 pp.

1928 The biological survey of a river system—its objects, methods and results. Ill. State Nat. Hist. Surv. Bull. 17:277-284.

1930 Concerning certain ecological methods of the Illinois Natural History Survey. Trans. Ill. State Acad. Sci. 21:19-25 (1929). Earlier version in brief in Science 66:405-406. 1927.

FORBES, S. A., AND GROSS, A. O.

1921 The orchard birds of an Illinois summer. Ill. State Nat. Hist. Surv. Bull. 14:1-8.

1922 The numbers and local distribution in summer of Illinois land birds of the open country. Ill. State Nat. Hist. Surv. Bull. 14:187-218.

1923 On the numbers and local distribution of Illinois land birds of the open country in winter, spring, and fall. Ill. State Nat. Hist. Surv. Bull. 14:397-453.

FORBES, STEPHEN A., AND OTHERS

1891 An analytical list of the entomological writings of William LeBaron, M.D., Second State Entomologist of Illinois. App. to 17th rept. Ill. State Entomologist, pp. 1-36 + index.

FORBES, S. A., AND RICHARDSON, R. E.

1905 On a new shovelnose sturgeon from the Mississippi River. Bull. Ill. State Lab. Nat. Hist. 7:37-44.

1909 The fishes of Illinois. Final Repts. on the Nat. Hist. of Ill. 3:131 + 357 pp., 56 pls.; 103 maps in a separate atlas. 2d ed., with 68 pls., in 1920.

1913 Studies on the biology of the upper Illinois River. Bull. Ill. State Lab. Nat. Hist. 9:481-574.

1919 Some recent changes in Illinois River biology. Ill. State Nat. Hist. Surv. Bull. 13:139-156.

FORD, EDWARD R., SANBORN, C. C. AND COURSEN, C. B.

1934 Birds of the Chicago region. Chicago Acad. Sci., Program of Activities 5 (nos. 2-3):17-80. Bibl., pp. 73-76. Index, map.

FORD, THOMAS

1854 History of Illinois, 1818-1847. Chicago. S. C. Griggs and Co. 447 pp.

FOSTER, JOHN WELLS (1815-1873)

1869 The Mississippi valley: its physical geography, including sketches of the topography, botany, climate, geology, . . . Chicago, S. C. Griggs and Co. 16 + 443 pp., maps. [Origin of prairies, pp. 71-140.]

FOSTER, T. D., AND VAN DEVENTER, W. C.

1934 A comparative study of river pool and pond communities, with special reference to the Sphaeriids. Trans. Ill. State Acad. Sci. 26:132. (1933.)

FOX, HENRY

1915 Notes on Orthoptera and orthopteran habitats in the vicinity of Lafayette, Indiana. Proc. Ind. Acad. Sci. 14:287-321.

FRAZIER, ZOE R.

1915 Notes on the ecology of Iowa lichens. Proc. Iowa. Acad. Sci. 21:67-75. (1914.)

FRED, E. B., WILSON, F. C., AND DAVENPORT, AUDREY

1924 The distribution and significance of bacteria in Lake Mendota [Wis.]. Ecology 5:322-339.

FRENCH, G. H.

1870 Some interesting plants of southern, Illinois. Am. Ent. and Bot. 2:383-384. [Plant list for Jackson county.]

1878 Lepidoptera [of Illinois]. In 7th rept. Ill. State Entomologist (by Cyrus Thomas), pp. 133-173.

1926 Some interesting southern Illinois plants. Trans. Ill. State Acad. Sci. 18:208-211. (1925.)

FRIESNER, RAY C., AND POTZGER, J. E.

1934 Climax conditions and the ecological status of Pinus strobus, Taxus canadensis and Tsuga canadensis in the Pine Hills region of Indiana. Butler Univ. Bot. Studies 3:65-83. See SMITH, E. R., 1933.

FRISON, THEODORE H.

1916 Note on the habits of Psithyrus variabilis Cress. Bull. Brooklyn Ent. Soc., 11:46-47.

1917 Notes on Bombidae, and on the life history of Bombus auricomus Robt. Ann. Ent. Soc. Am., 10:277-286.

1918 Additional notes on the life history of Bombus auricomus Robt. Ann. Ent. Soc. Am. 11:43-48.

1920 Keys for the separation of the Bremidae, or bumblebees, of Illinois, and other notes. Trans. Ill. State Acad. Sci. 12:157-165. (1919.)

1921 Antherophagus ochraceus Mels. in the nests of bumblebees. Am. Nat. 15:188-192.

1922 Notes on the life history, parasites and inquiline associates of Anthophora abrupta Say, with some comparisons with the habits of certain other Anthophorinae (Hymenoptera). Trans. Am. Ent. Soc. 48:137-157.

1924 Pollination, with particular reference to the bumblebee. Ill. State Beekeepers Assoc. 23d Ann. Rept. 1923:89-90.

1926 Contribution to the knowledge of the interrelations of the bumblebees of Illinois with their animate environment. Ann. Ent. Soc. Am. 19:203-235.

1927 Experiments in rearing colonies of bumblebees (Bremidae) in artificial nests. Biol. Bull. 52:51-67.

1927 The fertilization and hibernation of queen bumblebees under controlled conditions (Bremidae:Hym.). Jour. Econ. Ent. 20:522-526.

1927 The development of the castes of bumblebees (Bremidae:Hym.). Ann. Ent. Soc. Am. 20:156-180.

1928 A contribution to the knowledge of the life history of Bremus bimaculatus (Cress.) (Hym.). Entomologica Americana (new ser.) 8:159-223.

1929 Fall and winter stoneflies, or Plecoptera, of Illinois. Ill. State Nat. Hist. Surv. Bull. 18:341-409.

1929 A contribution to the knowledge of the bionomics of Bremus impatiens (Cress.) (Hym.) Bull. Brooklyn Ent. Soc. 24:261-265.

1930 Observations on the behavior of bumblebees (Bremus): The orientation flight. Can. Ent. 62:49-54.

1930 A contribution to the knowledge of the bionomics of Bremus vagans (F. Sm.). Bull. Brooklyn Ent. Soc. 25:109-122.

FRISON, THEODORE H.—*Continued*

1930 An insect survey of Illinois. 60th Rept. Ent. Soc. Ontario, 1929:141-146.

1930 A contribution to the knowledge of the bionomics of Bremus americanorum (Fabr.) (Hym.). Ann. Ent. Soc. Am. 23:644-665.

1935 The stoneflies, or Plecoptera, of Illinois. Ill. State Nat. Hist. Surv. Bull. 20 (Art. 4):281-471. (In press).

FRISON, T. H. AND MILLER, R. B.

1926 Illinois. Pp. 469-479 of Naturalist's guide to the Americas. See SHELFORD 1926.

FRISON, T. H. AND SNYDER, MARY J.

1925 Contents and index of the reports of the State Entomologist of Illinois, 25-29, 1909-1916. Appendix to 29th rept., 68 pp. See ANGE V. MILLER, 1885, and HART and SNYDER, 1909.

See also HOTTES and FRISON, 1931.

FRYXELL, F. M.

1927 The physiography of the region of Chicago. Univ. of Chicago Press. 55 pp., maps.

FULLER, GEORGE D.

1911 Evaporation and plant succession. Bot. Gaz. 52:193-208.

1912 Evaporation and plant succession on the sand dunes of Lake Michigan. Trans. Ill. Acad. Sci. 4:119-125. (1911).

1912 Evaporation and the stratification of vegetation. Bot. Gaz. 54:424-426.

1913 The vegetation of the Chicago region. [Publ. privately at University of Chicago for the International Phytogeographic Excursion in America.] 18 pp.

1914 Evaporation and soil moisture in relation to the succession of plant associations. Bot. Gaz. 58:193-234.

1916 Soil moisture and plant succession. Trans. Ill. State Acad. Sci. 7:68-73. (1914).

1916 A comparison of certain Rocky Mountain grasslands with the prairie of Illinois. Trans. Ill. Acad. Sci. 8:121-130. (1915).

1920 Soil as a limiting factor of forests in LaSalle County, Illinois. Trans. Ill. State Acad. Sci. 12:99-102. (1919).

1921 Notes on the distribution of the oaks and the buckeye in LaSalle County, Illinois. Trans. Ill. State Acad. Sci. 13:247-249. (1920).

1923 An edaphic limit to forests in the prairie region of Illinois. Ecology 4:135-140.

1925 The vegetation of the Chicago region. An outline of some of the principal plant associations together with lists of their principal species. Chicago, Univ. of Chi. Press. 27 pp.

FULLER, GEO. D., LOCKE, J. R., AND McNUTT, W.

1914 The stratification of atmospheric humidity in the forest. Trans. Ill. State Acad. Sci. 6:100-102. (1913).

FULLER, GEO. D., AND STRAUSBAUGH, P. D.

1920 On the forest of LaSalle County, Illinois. Trans. Ill. State Acad. Sci. 12:246-272. (1919).

FULLER, GEO. D., AND TELFORD, C. J.

1925 Some north and south stream valleys in Illinois and their vegetation. Trans. Ill. State Acad. Sci. 17:94-99. (1924).

FULLER, M. L., AND CLAPP, F. G.

1903 Marl-loess of the lower Wabash valley. Bull. Geol. Soc. Am. 14:153-176.

1904 Patoka Folio, Indiana. Geol. Atlas, U. S. Geol. Surv., no. 84.

FUNKHOUSER, W. D.

1925 Wild life in Kentucky. Ky. Geol. Surv., ser. 6, vol. 16. 385 pp. Bibl. pp. 354-360.

GANTZ, RICHARD A.

1920 Artificial key to the weed seeds found in commercial seeds in Illinois and adjoining states. Trans. Ill. State Acad. Sci. 11:135-144. (1918). Many figures; bibl.

GARMAN, H.

1886 . . . Life history of the corn plant-louse. In Trans. Ill. Dept. Agr. 23. (app.): 46-56.

1890 A preliminary report on the animals of the Mississippi bottoms near Quincy, Illinois. Bull. Ill. State Lab. Nat. Hist. 3:123-184.

1890 Notes on Illinois reptiles and amphibians, including several species not before recorded from the northern states. Bull. Ill. State Lab. Nat. Hist. 3:185-190.

1892 A synopsis of the reptiles and amphibians of Illinois. Bull. Ill. State Lab. Nat. Hist. 3:215-389.

1894 A preliminary list of the vertebrate animals of Kentucky. Bull. Essex Inst. 26:1-63.

1913 The woody plants of Kentucky. Ky. Agr. Exp. Sta., Bull. 169. 62 pp.

GARMAN, PHILIP

1917 The Zygoptera, or damsel-flies, of Illinois. Bull. Ill. State Lab. Nat. Hist. 12:411-587.

GASKILL, A.

1906 Why prairies are treeless. Proc. Soc. Am. Foresters 1:158-178.

GATES, F. C.

1911 Relic dunes, a life history. Trans. Ill. State Acad. Sci. 3:110-116. (1910).

1911 Summer bird life in the vicinity of Havana, Illinois, in its relation to the prominent plant associations. Wilson Bull. 23:1-27.

1911 A nomenclatorial problem with a description of a new form, Petalostemum purpureum f. arenarium. Torreya 11:125-128. [Prostrate habit in open dune environment.]

1911 A bog in central Illinois. Torreya 11:205-211. [Northern relic colony near Matanzas on the Illinois River.]

1912 The vegetation of the Beach area in northeastern Illinois and southeastern Wisconsin. Bull. Ill. State Lab. Nat. Hist. 9:255-372.

1923 Contribution to the flora of Cass County, Illinois. Trans. Ill. State Acad. Sci. 15:165-170. (1922).

1926 Contributions to the flora of Hancock County, Illinois. Trans. Ill. State Acad. Sci. 18:225-234. (1925).

GAULT, BENJAMIN TRUE

1922 Check list of the birds of Illinois, together with a short list of 200 commoner birds and Allen's Key to birds' nests. Chicago. Ill. Audubon Soc. 80 pp., map.

GERHARD, FRED.

1857 Illinois as it is; its history, geography, . . . climate, soil, plants, animals, . . . prairies, agriculture . . . etc., etc. With a prairie and wood map, a geological map, a population map, and other illustrations, Chicago, Keen and Lee. 451 pp. [Biological parts, incl. the prairie and wood map, contributed by Frederick Brendel, pp. 238-247, 270-278.]

GEYER, CHARLES A. See ENGELMAN, GEORGE, 1843.

GILMAN, J. C.

1926 A partial list of the parasitic Ascomycetes of Iowa. Proc. Iowa Acad. Sci. 32:225-264. (1925). [Host index. Bibl. of Iowa fungi.]

GIRAULT, A. A.

1910 Notes on variation in duration of similar periods of embryonic development: its bearing on the theory of effective temperatures. Bull. Wis. Nat. Hist. Soc. 8:11-20.

GLEASON, HENRY ALLAN

1901 The flora of the prairies. B. S. thesis, Univ. Ill.

1903 Notes on some southern Illinois plants. Torreya 3:1-3.

1904 The vegetation of the Ozark region in southern Illinois. Master's thesis, Univ. Ill.

1906 Some phytogeographical features of the prairies. Abstract, Science 23:874.

1907 See article in HART and GLEASON, 1907.

1909 Some unsolved problems of the prairies. Bull. Torr. Bot. Club 36:265-271.

1910 The vegetational history of a river dune. Trans. Ill. State Acad. Sci. 2:19-26. (1909).

1910 The vegetation of the inland sand deposits of Illinois. Bull. Ill. State Lab. Nat. Hist. 9:23-174.

1912 An isolated prairie grove and its phytogeographical significance. Bot. Gaz. 53:38-49. [Bur Oak Grove, Champaign Co.]

1913 The relation of forest distribution and prairie fires in the Middle West. Torreya 13:173-181. [Bur Oak Grove, Mink Grove w. of Rantoul, Linn Grove s. e. of Philo, named from linden.—Forest belts narrower on w. sides of streams.—Reduction of forests by fires particularly great on moraines—Hazel the characteristic former forest-border shrub.]

1923 The vegetational history of the Middle West. Ann. Assoc. Am. Geogr. 12:39-85.

1927 Further views on the succession-concept. Ecology 8:299-326. [Succession in Ill. as between forest and prairie has proceeded in both directions, even at the same time, p. 306.]

GLEASON, H. A. AND GATES, F. C.

1912 A comparison of the rates of evaporation in certain associations in central Illinois. Bot. Gaz. 53:478-491.

GLENN, GAIL G., AND WELCH, WINONA M.

1931 Ecological relations of the most common mosses in a certain vicinity near Bloomington, Indiana. Proc. Ind. Acad. Sci. 40:87-101. [pH of substrata; succession on sandstone, on limestone, and on wood. Tops of slopes compared with bases.]

GLENN, P. A.

1932 Use of temperature accumulations as an index to the time of appearance of certain insect pests during the season. Trans. Ill. State Acad. Sci. 24:167-180. (1931).

GOELLNER, EUGENE J.

1932 A new species of termite, Reticulitermes arenincola, from the sand dunes of Indiana and Michigan, along the shores of Lake Michigan. Proc. Ent. Soc. Wash. 33:227-234. [Type locality Pine, Ind.]

GOLDTHWAIT, J. W.

1907 The abandoned shore-lines of eastern Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. 17:2-9.

1908 The records of the extinct lakes. Ill. State Geol. Surv. Bull. no. 7:54-68. (See ATWOOD and GOLDTHWAIT, 1908.)

1909 Physical features of the DesPlaines valley. Ill. Geol. Surv. Bull. no. 11. 103 pp.

GOODMAN, P. S.

1920 Map of the Indiana dunes. Rand McNally and Co., Chicago.

GORBY, S. S.

1886 Geology of Benton County [Indiana]. Ind. Dept. Geol. and Nat. Hist., Ann. Rept. 15:198-220. (1886). [pp. 202-203, Timber: isolated groves in prairie well described. Parish Grove the largest, 7 miles from other forest. Bur oak, hackberry, elm, walnut, linden. This grove the summer home of Kickapoo Indians.]

GORDON, ROBERT B.

1932 The primary forest types of the east-central states. Ohio State Univ., Abstracts Doctors' Dissertations 8:42-52. O.S.U. Press. Map, p. 45. [4 types recognized of n. conifer forest, 12 types of e. deciduous forest, which is made to include some of the s.e. types, as cypress-tupelo gum.]

GRAENICHER, S.

1909 Wisconsin flowers and their pollination. Bull. Wis. Nat. Hist. Soc. 7:19-77.

1910 The bee-flies (Bombyliidae) in their relations to flowers. Bull. Wis. Nat. Hist. Soc. 8:91-101.

GRAHAM, V. O.

1927 Seasonal occurrence of the larger fungi. Trans. Ill. State Acad. Sci. 19:182-186. (1926).

1931 The genus Hygrophorus in the Chicago region. Trans. Ill. State Acad. Sci. 23:160-168. (1930).

1933 Mushrooms of the Chicago region. Chicago Acad. Sci., Program of Activities 4 (no. 3): 41-63.

1934 Ecology of Ascomycetes of the Chicago region. Trans. Ill. State Acad. Sci. 25:120-121. (1932).

GRANT, F. R., AND HAGUE, STELLA M.

1932 A list of mosses from Vermilion County, Illinois. Trans. Ill. State Acad. Sci. 24:122-123. (1931).

GREEN, ELDRED E.

1934 The physiographic and horticultural ecology of the Beverly (Blue Island) ridge. Trans. Ill. State Acad. Sci. 25:122-123. (1932).

GREENE, E. L.

1869 The botany of central Illinois. Am. Nat. 3:5-8. [Very general.]

GREENE, WESLEY

1907 . . . Plants of Iowa; a preliminary list of the native and introduced plants of the state, not under cultivation . . . (Bull. State Hort. Soc.) Des Moines, Bishard Bros., 264 pp. [Brief notes on habitat and abundance. 3115 spp. listed, incl. thallophytes and bryophytes up to no. 1505.]

GRIMES, E. J., AND STEVENS, E. H.

1915 Soil survey of Warren County [Ind.] Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 39:145-189. [Prairie areas, incl. those of Wabash terraces, pp. 145, 175, 177. Scattered prairie groves on Blue Ridge moraine in Prairie Twp.]

GRONEMANN, CARL F.

1927 Some new insect galls. Trans. Ill. State Acad. Sci. 19:195-196. (1926). [4 types from plants near Elgin, Ill.]

1930 Witches brooms of the Chicago area. Trans. Ill. State Acad. Sci. 22:150-151. (1929).

1930 Fifty common plant galls of the Chicago area. Field Mus. Nat. Hist., Bot. Leaflet no. 16. 30 pp.

GROVES, JAMES F.

1916 Evaporation and soil moisture in forests and cultivated fields. Trans. Ill. [State] Acad. Sci. 7:59-67. (1914).

GUTHRIE, J. E.

1926 The snakes of Iowa. Iowa Agr. Exp. Sta. Bull. 1926-28:145-192. (Bull. no. 239).

HAGUE, STELLA M.

1930 Illinois mosses. Trans. Ill. State Acad. Sci. 22:220-249. (1929).

HAGUE, STELLA M., AND HOLMES, STELLA A.

1934 A report of mosses collected from Coles and Crawford counties, Illinois. Trans. Ill. State Acad. Sci. 25:124-126. (1932).

HAHN, WALTER L.

1907 Notes on mammals of the Kankakee Valley. Proc. U. S. Nat. Mus. 32:455-464. [n. w. Ind., incl. marsh, meadow, and dune habitats.]

1908 Some habits and sensory adaptations of cave-inhabiting bats. Biol. Bull. 15:135-193.

1908 Notes on the mammals and cold-blooded vertebrates of the Indiana University farm, Mitchell, Indiana. Proc. U. S. Nat. Mus. 35:545-581.

HAHN, WALTER L.—*Continued*

1909 The mammals of Indiana. A descriptive catalogue of the mammals occurring in Indiana in recent times. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 33:417-663. (1908). [Geogr. distr., pp. 422-423; relation to environment, 423-430, table summarizing habitats, etc., p. 431.]

1910 Analytic study of faunal changes in Indiana. Am. Midl. Nat. 1:145-156, 171-185.

1913 The future of the North American fauna. Pop. Sci. Mo. 82:169-177.

HALL, ELIHU

1870 The genus Quercus in Menard county, Ill. Am. Ent. and Bot. 2:191. [10 spp., with estimated relative abundance in virgin forests.]

See WOLF and HALL, 1878.

HALL, JAMES (1793-1868)

1828 Letters from the West, containing sketches of scenery, manners, and customs. London, 385 pp.

1838 Notes on the western states, containing descriptive sketches of their soil, climate, resources, and scenery. Philadelphia. 304 pp.

HALL, R. C., AND INGALL, O. D.

1911 Forest conditions in Illinois. Bull. Ill. State Lab. Nat. Hist. 9:175-253.

HAMMAR, C. H., AND KRUSEKOPF, H. H. (Editors)

1933 Proceedings of the first Missouri conference on land utilization. Mo. Agr. Exp. Sta., Bull. no. 323. 62 pp.

HANCOCK, J. L.

1894 Unusual flights of the grouse locust (Tettigidea lateralis Say), in northeastern Illinois. Am. Nat. 28:483-487, and pl. 13, opp. p. 496. [Swarms appeared in Chicago, Sept. 1893, following drought. Movement partly due to winds from south.]

1911 Nature sketches in temperate America. A series of sketches and a popular account of insects, birds, and plants, treated from some aspects of their evolution and ecological relations. Chicago, A. C. McClurg & Co., 18 + 451 pp., 215 figs., 12 col. pls. [n. Ind. dunes, pp. 295-300; ecology of Orthoptera, especially in Ill., Ind., and s. Mich., pp. 324-429. Index, pp. 435-451.]

HANKINSON, T. L.

1911 An ecological study of the fish of a small stream. Trans. Ill. State Acad. Sci. 3:23-31 (1910).

1914 Distribution of fish in the streams about Charleston, Illinois. Trans. Ill. State Acad. Sci. 6:102-113. (1913).

1915 The vertebrate life of certain prairie and forest regions near Charleston, Illinois. Bull. Ill. State Lab. Nat. Hist. 11:281-303. See ADAMS, C. C., 1915.

1918 Amphibians and reptiles of the Charleston region. Trans. Ill. [State] Acad. Sci. 10:322-330. (1917).

1920 Notes on life-histories of Illinois fish. Trans. Ill. State Acad. Sci. 12:132-150 (1919). [Extensive bibl.]

HANSEN, ROY AND BURRILL, T. J.

1917 Is symbiosis possible between legume bacteria and non-legume plants? Ill. Agr. Exp. Sta., Bull. no. 202:115-181. Bibl. pp. 161-181.

HARMAN, J. A.

1913 Report and plans for reclamation of land subject to overflow in the Embarrass River valley. Ill. State Geol. Surv. Bull. no. 25. 61 pp., maps, profiles.

1916 Report and plans for reclamation of land subject to overflow in the Spoon River valley. Ill. State Geol. Surv. Bull. no. 32. 57 pp., maps, profiles.

HARPER, R. M.

1918 Review of Hall and Ingall on Illinois forests. Torreya 18:166-171. [p. 171: "Or it may be that the beech avoids the richest soils, with abundant soil fauna, such as characterize most of Ill."]

HARRIS, HUBERT A.

1934 Late winter injury to some common trees and shrubs. Abstract. Trans. Ill. State Acad. Sci. 26:67. (1933).

HARSHBERGER, JOHN W.

1911 Phytogeographic survey of North America. (A consideration of the phytogeography of the North American continent, including Mexico, Central America, and the West Indies, together with the evolution of North American plant distribution.) Vol. 13 of Die Vegetation der Erde. Leipzig, W. Engelmann; New York, G. E. Stechert and Co. 790 pp., large colored map. [Ill. veg., pp. 398-401; 456-458; 505, 507; 519-526.]

HART, C. A.

1895 On the entomology of the Illinois River and adjacent waters. Bull. Ill. State Lab. Nat. Hist. 4:149-273.

1903 1906 Synopsis of insect collections for distribution to Illinois high schools. I. Lepidoptera (pp. 1-64, 1903). II. Orthoptera (pp. 65-92, 1906). Ill. State Lab. Nat. Hist., Urbana.

1909 Biotic zones and districts in Illinois. Abstract. Trans. Ill. State Acad. Sci. 1:57-58. (1908). [Transition zone in n. e. Ill.; n. e. sand area, adjoining L. Mich. and in Kankakee Valley; w. and n. w. sand areas in Ill. and Miss. River Valleys; n. prairie, to lat. of Shelbyville; s. prairie; Ozark ridge and river valley area; Lower Austral zone s. of Ozarks.]

1919 The Pentatomoidea of Illinois. Bull. Ill. State Lab. Nat. Hist. 13:157-223.

HART, C. A., AND GLEASON, H. A.

1907 On the biology of the sand areas of Illinois. Bull. Ill. State Lab. Nat. Hist. 7:137-272.

HART, C. A., AND SNYDER, MARY J.

1909 Contents and index of the reports of the State Entomologist of Illinois, 13-24, 1884-1908. Appendix to 24th rept., 157 pp. See ANGE V. MILLER, 1885, and FRISON and SNYDER, 1925.

HARVEY, EDWARD M.

1914 Evaporation and soil moisture on the prairies of Illinois. Trans. Ill. State Acad. Sci. 6:92-99. (1913).

HAY, OLIVER PERRY

See LULL, 1931. [Bibl. of Hay's writings.]

1878 An examination of Prof. Leo Lesquereux's theory of the origin and formation of prairies. Am. Nat. 12:299-305. [Hay shows that prairies do not in most areas form upon lacustrine deposits.]

1887 The red-headed woodpecker a hoarder. The Auk 4:193-196. [It stores beechnuts, acorns, and other hard-coated fruits.]

1887 The massasauga and its habits. Am. Nat. 21:211-218.

1892 On the breeding habits, eggs, and young of certain snakes. Proc. U. S. Nat. Mus. 15:385-397. Paper of same title in Proc. Ind. Acad. Sci. 1891:106-120. [Observations in Ill. and Ind. included.]

1892 The batrachians and reptiles of the state of Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 17:409-609. (1891). [30 batrachian and 51 reptile spp.]

1895 The lampreys and fishes of Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 19:146-296. (1894).

1896 On some collections of fishes made in the Kankakee and Illinois rivers. Publs. Field Columbian Mus. Zool. 1:85-97.

1909 The geological and geographical distribution of some Pleistocene mammals. Science 30:890-893.

1910 On the changes of climate following the disappearance of the Wisconsin ice sheet. Die Veränderungen des Klimas seit dem letzten Eiszeit: 11th Internat. Geol. Congr., Stockholm 1910:371-374.

1912 The Pleistocene period [in Indiana] and its Vertebrata. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 36:539-784. (1911).

1914 The Pleistocene mammals of Iowa. Iowa Geol. Surv., Ann. Rept. 23:1-662. 75 pls., 142 figs.

1923 The Pleistocene of North America and its vertebrated animals from the states east of the Mississippi River and from the Canadian provinces east of longitude 95°. Carnegie Inst. Wash., Publ. no. 322. 499 pp.

1927 The prong-horn antelope in Illinois. Jour. Mamm. 8:61-62. [Pleistocene or early Recent remains, n. w. Ill.]

HAY, W. P.

1892 The Crustacea of Indiana. Proc. Ind. Acad. Sci. 1891:147-150.

1896 The crawfishes of the state of Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 20:475-507. (1895.)

HAYDEN, ADA

1913 Scattering of weeds. Iowa Geol. Surv. Bull. no. 4:627-640.

1919 Notes on the floristic features of a prairie province. Proc. Iowa Acad. Sci. 25:369-389. (1918).

1919 The ecologic foliar anatomy of some plants of a prairie province in central Iowa. Am. Jour. Bot. 6:69-85. 6 pls.

1919 The ecologic subterranean anatomy of some plants of a prairie province in central Iowa. Am. Jour. Bot. 6:87-105. 14 pls.

1926 The story of weed seed dissemination. Iowa Geol. Surv. Bull. no. 4 (revised ed.), pp. 561-574.

HAYES, WILLIAM P.

1927 Prairie insects. Ecology 8:238-250.

1931 Morphology, taxonomy, and biology of larval Scarabaeoidea. Ill. Biol. Mon. 12(2):85-119. (1929). [Biol. and ecol. literature, p. 13; devel. and biol. 47-71.]

HEBARD, MORGAN

1934 The Dermaptera and Orthoptera of Illinois. Ill. State Nat. Hist. Surv. Bull. 20 (Art. 3):125-279. Chapters by H. H. Ross: Biology and habits of the orders, and Ecological factors affecting Orthoptera, pp. 125-135.

HEIMLICH, LOUIS F.

1918 The trees of White county, Indiana, with some reference to those of the state. Proc. Ind. Acad. Sci. 1917:387-471. [Detailed account with colored maps, annotated list of spp.]

1921 to 1923 Native plants of White county. A series in Proc. Ind. Acad. Sci.: I deals with the primrose-leaved violet (1914:213-217). II is the preceding item on trees of the county. III to V constitute a local flora of herbs, shrubs, and woody vines.—III. 1920:219-224.—IV. 1921:117-119.—V. 1922:281-289.

HEMPEL, ADOLPH

1899 A list of the Protozoa and Rotifera found in the Illinois River and adjacent lakes at Havana, Illinois. Bull. Ill. State Lab. Nat. Hist. 5:301-388.

HENDERSON, JOHN G.

1872 The former range of the buffalo. Am. Nat. 6:79-98. Many quotations from early French travelers, relating to bison in Illinois and elsewhere.

HENDERSON, LENA B.

1929 The plants of Castle Rock. A preliminary report. Trans. Ill. State Acad. Sci. 21:144-151. (1928).

HENDRICKSON, G. O.

1928 Some notes on the insect fauna of an Iowa prairie. Ann. Ent. Soc. Am. 21:132-138.

1930 Studies on the insect fauna of Iowa prairies. Iowa State Coll. Jour. of Sci. 4:49-180.

1931 Notes on vertebrates of Iowa prairies. Proc. Iowa Acad. Sci. 37:398-399. (1930).

HESS, ISAAC E.

1910 One hundred breeding birds of an Illinois ten-mile radius. The Auk 27:19-32. Center at Philo, Champaign co.

HIGLEY, WILLIAM KERR

1902 Historical sketch of the Academy. Chicago Acad. Sci. Special Publ. no. 1. 52 pp., pls. (publ. also in vol. 2 of BLANCHARD'S History of the Northwest.)

HIGLEY, WILLIAM KERR, AND RADDIN, CHARLES S.

1891 The flora of Cook county, Illinois, and a part of Lake county, Indiana. Bull. Chicago Acad. Sci. vol. 2, no. 1, 23 + 168 pp. [1042 native plant species with notes on habitat, localities, season, and abundance. List preceded by descriptive sections, including sketch of H. H. BABCOCK, author of Chicago flora and director of the Chicago Botanical Garden in South Park (1874-77). Other sections describe physical geography of Cook co., forest trees, plants and localities of special interest, etc.]

HILL, E. J.

1881 Plants and plant-stations. Bull. Torr. Bot. Club 8:45-47. [A few plants in various habitats at Englewood, L. Mich. dunes, banks of Kankakee River, etc.]

1881 Botanical notes. [Plant localities, Ill., Ind., Mich.] Bot. Gaz. 6:259-263.

1883 Notes on Indiana plants. Bot. Gaz. 8:187-188. Cont. 1884, 9:45-48.

1885 Some Indiana plants. Bot. Gaz. 10:262-263. Cont. 1888, 13:323.

1890 Pinus Banksiana at the west. Bull. Torr. Bot. Club. 17:64-67.

1890 The revised manual and some western plants. Bull. Torr. Bot. Club 17:169-174. [Distr. in Ill. and near L. Mich.]

1892 Notes on the flora of Chicago and vicinity. I. Bot. Gaz. 17:246-252.

1896 II. Bot. Gaz. 21:118-122.

1896 The sand dunes of northern Indiana and their flora. Garden and Forest 9:353-354, 373-374, 382-383, 393-394.

1897 Ecological notes on the white pine. Garden and Forest 10:331-332. [Ind. dunes and elsewhere, not Ill. Wide range of adaptability to soils and to moisture conditions.]

1899 A new biennial-fruited oak [Quercus ellipsoidalis.] Bot. Gaz. 27:204-208. [First recognized near southern limits of Chicago.]

1899 Notes on plants of the Chicago district. Bull. Torr. Bot. Club 26:303-311.

1899 The habitats of the Pellaeas. Bull. Torr. Bot. Club 26:596-598. [Limestone ledges, lower DesPlaines valley.]

1900 The southern limit of Juniperus sabina. Plant World 3:140.

1902 Notes on migratory plants. Bull. Torr. Bot. Club 29:564-570. [Incursions of weeds and certain native plants into Ill. and L. Mich. dunes.]

1906 Distribution and habits of some common oaks. Bot. Gaz. 41:445-447. [A brief confirmatory note in] 42:59. 1907.

1912 The fern flora of Illinois. Fern Bull. 20:33-43.

1915 Notes on plants of the Chicago region. Torreya 15:21-28.

1927 The southern and southwestern moraine and the adjacent low-lying regions, portions of Cook, Will, and DuPage counties, Illinois. Pp. 63-100 of PEPOON, 1927, Flora of the Chicago region (q.v.). [Mr. Hill died in 1917.]

HINRICHS, G. D.

1880 Rainfall and timber in Iowa. Trans. Iowa Hort. Soc. 14:198-201.

HOLDER, R. H.

1861 Birds of Illinois. Catalogue. Trans. Ill. State Agr. Soc. 4:605-613. (1859-60). [152 spp. Names only.]

HOLLISTER, NED

1910 A check list of Wisconsin mammals. Bull. Wis. Nat. Hist. Soc. 8:21-31.

HOLMES, C. L.

1929 Types of farming in Iowa. Iowa Agr. Exp. Sta. Bull. 1928-29:113-166. (Bull. no. 256). [Numerous maps, showing precipitation, length of growing season, prevailing soil types (with which the 6 type-of-farming areas are closely correlated) and data on particular farm products.]

HOLMES, J. S., AND BRADFORD, WESLEY

1908 First report on a study of the forest conditions of Kentucky made by the Forest Service, U. S. Dept. Agr. Bienn. Rept. Ky. Commr. Agr., Labor, and Statistics, 1907:67-94.

HOLMQUIST, A. M.

1926 Studies in arthropod hibernation.
I. Ecological survey of hibernating species from forest environments of the Chicago region. Ann. Ent. Soc. Am. 19:395-429.

1928 II. Hibernation of the ant, Formica ulkei Emery. Physiol. Zool. 1:325-357.

1931 III. Temperatures in forest hibernacula. Ecology 12:387-400.

1928 Notes on the life-history and habits of the mound-building ant, Formica ulkei Emery, Ecology 9:70-87. [Colonies at Palatine and Palos Park, Ill.]

HOOKOM, DON W.

1931 A study of the Membracidae known to occur in Iowa. Proc. Iowa Acad. Sci. 37:385-386. (1930). [Earlier list by H. OSBORN, vol. 1, part 2:128. 1892 (1890-1891).]

HOPKINS, CYRIL G.

1907 Illinois soils in relation to systems of permanent agriculture. Rept. Ill. Farmers' Inst. 12:247-263.
See also Illinois Soil Survey. [Hopkins was one of the leading authors of the early county reports of the Survey.]

HOPKINS, C. G., MOSIER, J. G., AND BAUER, F. C.

1916 Summary of Illinois soil investigations. Bull. Univ. Ill. Agr. Exp. Sta. 13:449-484. (No. 193). [With colored soil map, as in Bull. 123.]

HOPKINS, C. G., AND PETTIT, J. H.

1908 The fertility of Illinois soils. Bull. Ill. Agr. Exp. Sta. 8:187-294. (No. 123). [With colored soil map of Ill., largely based on Leverett's glacial map. Moraines and till-plains of different ages are shown.]

HOPKINS, C. G., READHIMER, J. E., AND FISHER, O. S.

1912 Peaty swamp lands; sand and "alkali" soils. Bull. Univ. Ill. Agr. Exp. Sta. 11:95-131. (No. 157. 137 pp.)

HOPKINS, C. G., AND WHITING, A. L.

1916 Soil bacteria and phosphates. Bull. Univ. Ill. Agr. Exp. Sta. 13:391-406. (No. 190).

HORTON, A. H.

1914 Water resources of Illinois. Ill. Rivers and Lakes Commission. Springfield. 400 pp.

HOTTES, F. C., AND FRISON, T. H.

1931 The plant lice, or Aphiidae, of Illinois. Ill. Nat. Hist. Surv. Bull. 19:119-447. Host index (389-403), bibl. (404-417), 10 pls.

HOUDEK, PAUL K.

1924 An ecological survey and flora of Lake Knox. Trans. Ill. State Acad. Sci. 16:163-170. (1923). See ADCOCK, 1923.

1933 Pollen statistics for two Indiana bogs. Proc. Ind. Acad. Sci. 42:73-77. [One bog at Mineral Springs, in L. Mich. dune area.]

HOWARD, ARTHUR DAY

1914 Experiments in the propagation of fresh-water mussels of the Quadrula group. U. S. Bur. Fish. Doc. 801. 50 pp.

HUBBARD, F. T.

1917 Andropogon scoparius in the United States and Canada. Rhodora 19:102-103.

HUBBELL, THEODORE H.

1929 The distribution of the beach grasshoppers Trimerotropis huroniana and Trimerotropis maritima interior in the Great Lakes region (Orthoptera, Acrididae). Jour. N. Y. Ent. Soc. 37:31-39.

HUBBS, CARL L.

1919 The nesting habits of certain sunfishes as observed in a park lagoon in Chicago. Aquatic Life 4:143-144.

HUELS, F. W.

1915 The peat resources of Wisconsin. Wis. Geol. Surv. Bull. 45: (Econ. Ser. no. 20.) Map shows bog and swamp areas.

HUESING, MARGARET

1932 Hexagonal spacing in native vegetation. M. A. thesis, Univ. of Ill. 32 pp., veg. maps of small areas. [Incl. space-arrangement of spice-bush in Brownfield Woods.]

HUETT, J. W.

1897 Essay toward a natural history of LaSalle county, Ill. Part I—Botany, Flora LaSallensis. 4 + 137 pp. Part II—Geology and Zoology. 9 + 174 pp. Ottawa, Ill., Fair Dealer Print.

HULL, H.

1922 [Article on Starved Rock.] See COWLES, SMITH, et al., 1922.

HURTER, JULIUS

1884 List of birds collected in the neighborhood of St. Louis, Mo. Ornithologist and Oologist 9:85-87, 95-97, 128. 265 spp., brief notes.

1893 Catalogue of reptiles and amphibians found in the vicinity of St. Louis, Mo. Trans. Acad. Sci. St. Louis 6:251-261. (1892-1894). [St. Louis co., Mo., and "American Bottoms" in St. Clair and Madison counties, Ill.]

1911 Herpetology of Missouri. Trans. Acad. Sci. St. Louis 20:59-271. Two earlier papers on same subject, 7:499-503, and 13:77-86.

HUS, HENRI

1908 An ecological cross-section of the Mississippi River in the region of St. Louis, Missouri. Ann. Rept. Mo. Bot. Gard. 19:127-258.

HYATT, JAMES

1875 Western plants. Bull. Torr. Bot. Club 6:66-68. [Trip N. Y. to Peoria.]

ILLICK, JOSEPH S.

1927 Common trees of Indiana. Publ. and distributed by Am. Tree Assoc., Washington, D. C. 111 pp. A popular handbook.

ILLINOIS BOARD OF PARK ADVISORS

1933 Report on the system of state parks in Illinois. Springfield, Schnepp & Barnes, printers. 71 pp., maps. (1932). See SERVICE, 1920, 1925.

ILLINOIS COUNTY ATLASES. See PHILLIPS, P. L., 1909.

ILLINOIS FISH COMMISSON

1880 to 1912 First report 1880, 2d 1882. Biennial reports begin with vol. publ. 1886. Continued by Illinois Game and Fish Commission, Annual Report 1913-1914 et seq.

ILLINOIS, GAME AND FISH COMMISSION

1913 Annual reports beginning 1913.

ILLINOIS SOIL SURVEY, AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF ILLINOIS, R. S. SMITH, Chief of Soil Physics and Mapping.

Soil reports are published for 56 of the 102 counties as follows:

1911	1. Clay	1921	20. Bureau	1927	38. Ogle
	2. Moultrie		21. McHenry		39. Logan
1912	3. Hardin	1922	22. Iroquois	1928	40. Whiteside
	4. Sangamon		23. DeKalb		41. Henry
1913	5. LaSalle		24. Adams		42. Morgan
	6. Knox	1923	25. Livingston	1929	43. Douglas
	7. McDonough	1924	26. Grundy		44. Coles
	8. Bond		27. Hancock		45. Macon
1915	9. Lake		28. Mason	1930	46. Edwards
	10. McLean	1925	29. Mercer		47. Piatt
	11. Pike		30. Johnson	1931	48. Effingham
1916	12. Winnebago		31. Rock Island		49. Wayne
	13. Kankakee		32. Randolph		50. Macoupin
	14. Tazewell	1926	33. Saline		51. Fulton
1917	15. Edgar		34. Marion	1932	52. Fayette
	16. DuPage		35. Will		53. Calhoun
	17. Kane	1927	36. Woodford	1933	54. Ford
1918	18. Champaign		37. Lee		55. Jackson
1921	19. Peoria			1934	56. Schuyler

Soil maps are available for the following counties (reports not yet published):

Clinton	Jasper	Vermilion
Crawford	Monroe	Wabash
Cumberland	Pulaski	Washington
Franklin	St. Clair	White

County soil maps in process of engraving and printing:

Alexander	Shelby
Cumberland	Stark
(revised)	Warren

Each soil report is the work of several joint authors. The following list includes the names of authors of reports thus far published: F. C. Bauer, R. W. Dickenson, O. I. Ellis, E. E. DeTurk, F. A. Fisher, O. S. Fisher, F. W. Garrett, S. V. Holt, C. G. Hopkins, W. R. Leighty, J. G. Mosier, E. A. Norton, J. H. Pettit, J. E. Readhimer, L. H. Smith, R. S. Smith, H. J. Snider, H. W. Stewart, E. Van Alstine, and F. W. Wascher. On the next reports to be published will appear other names, including those of Eric Winters, Jr., and Herman Wascher.

See also AGRONOMY DEPARTMENT, UNIVERSITY OF ILLINOIS.

ILLINOIS STATE GEOLOGICAL SURVEY

1917 Geologic map of Illinois, 4th ed. 35 x 51 inches. 1st ed. in Bull. 1 of Ill. Geol. Surv. 1906.

1925 Base map of Illinois, 5th ed. Replaces earlier eds. 31 x 51 inches, approx. 8 miles to the inch.

Other maps, incl. numerous special topographic maps. See list of publs., Ill. Geol. Surv.

1933 List of publications on the geology, mineral resources, and mineral industries of Illinois, with appended index. Urbana, Sept. 1, 1933. 83 pp. Incl. series of misc. publs., 1906 to 1933, based on data of the Ill. Surv., but published elsewhere.

IMLAY, GILBERT

1797 Topographical description of the western country of North America; containing a succinct account of its climate, natural history, population, agriculture, manners and customs, with an ample description of the several divisions into which that country is divided. . . . Ed. 3. London. 598 pp., maps.

IOWA STATE PARKS BULLETIN

1923 to 1927 Publ. bimonthly by Iowa State Board of Conservation. Vol. 1, 1923-24; Vol. 2, 1924-25; Vol. 3, 1925-26, 192 pp.; Vol. 4, 1926-27, 168 pp. [Map of Iowa locating parks and other areas of interest, 3:112-113. Notice of discontinuance at end of Vol. 4.—Many very short non-technical articles. See PAMMEL et al, 1920.]

ISENBARGER, J.

1934 A contrast of plant habitats, with reference to hydrogen ion concentration and plant distribution. Trans. Ill. State Acad. Sci. 25:126-128. (1932). [Thornton woods, 22 mi. s. of Chicago; sphagnum bog near Lake Villa, Lake co.]

JACKSON, HARTLEY H. T.

1910 The distribution of certain Wisconsin mammals. Bull. Wis. Nat. Hist. Soc. 8:86-90.

JANVRIN, CHARLES E.

1917 The scientific writings of Thomas J. Burrill. Trans. Ill. State Hort. Soc. 51:195-201.

JAQUES, H. E.

1927 A preliminary survey of May beetles (Phyllophaga spp.) in Iowa. Proc. Iowa Acad. Sci. 33:337-339. (1926).

1928 A further report on the May beetles (Phyllophaga spp.) in Iowa. 34:314-315. (1927).

Other Phyllophaga papers by H. E. Jaques—29:163-164; 32:423-424; 35:303-304; 36:371; 37:387-388.

JENNY, HANS

1928 Relation of climatic factors to the amount of nitrogen in soils. Jour. Am. Soc. Agron. 20:900-912.

1929 Relation of temperature to the amount of nitrogen in soils. Soil Sci. 27:169-188.

1930 The nitrogen content of the soil as related to the precipitation-evaporation ratio. Soil Sci. 29:193-206.

JENSEN, JENS

1929 The native beeches in the Chicago region. Trans. Ill. State Acad. Sci. 21:69-71. (1928).

JEWELL, MINNA E.

1920 The quality of water in the Sangamon River. Ill. State Water Surv. Bull. No. 16:230-246.

1922 The fauna of an acid stream. Ecology 3:22-28. [Suggestions that certain laboratory studies of pH relations of fishes may require reinterpretation in the light of field data.]

JILLSON, W. R.

1926 Kentucky State Parks. Ky. Geol. Surv., Ser. 6, Pamphlet 6. 14 pp.

1927 The topography of Kentucky. Ky. Geol. Surv., Ser. 6, vol. 30:1-60.

1929 Kentucky state maps. Packet containing 3 large folded maps: Geol. map, 1927. Base map, 1928. Relief map, 1924. Ky. Geol. Surv., Ser. 6.

JOHNS, M. RAE

1930 Heliantheae of Iowa. I. Proc. Iowa Acad. Sci. 36:147-184. (1929).

1931 II. Proc. Iowa Acad. Sci. 37:161-208. (1930). [Photographs of composites in native prairie veg., etc.—other field data.]

JOHNSON, BENJAMIN F.

1861 Report of Committee on Farms and Nurseries, for 1859. Trans. Ill. State Agr. Soc. 4:83-95. (1859-60). [In discussing the growing of orchards, pp. 88-89: "The prairies remain prairies because trees grow naturally . . . only where there is natural drainage, as about ravines and along the banks of rivers in prairie countries, . . ."]

JOHNSON, EVERETT L.

1924 Relation of sheep to climate. Jour. Agr. Res. 29:491-500. [Environmental conditions in Illinois as related to requirements of sheep.]

JOHNSON, J. STODDARD

1898 The first explorations of Kentucky. Filson Club Publ. no. 13:154-155.

JONES, ABNER DUMONT

1838 Illinois and the west; with a township map containing the latest surveys and improvements. Boston. 255 pp.

JONES, DAVID T. See POTTER, G. E., AND JONES, D. T.

JONES, F. R., AND TISDALE, W. B.

1921 Effect of soil temperature upon the development of nodules on the roots of certain legumes. Jour. Agr. Res. 22:17-31.

JONES, GEORGE

1838 Some observations made in Holland, connected with our prairie region. Am. Jour. Sci. and Arts, Ser. 2, 33:226-230. [Descr. of "barrens" in Ind.—in this case sand-hills covered with white oak, alternating with wet prairies in depressions.]

JONES, L. R., JOHNSON, J., AND DICKSON, J. G.

1926 Wisconsin studies upon the relation of soil temperature to plant disease. Wis. Agr. Exp. Sta. Res. Bull. no. 71. 144 pp.

JONES, P. M.

1927 Origin of the prairies of the middle west. Sci. 66:329-330. [Rapid drainage at close of ice age.—This theory perhaps of local validity; it is similar to some others advanced many years ago. A. G. V.]

JONES, WELLINGTON D.

1930 A method of determining the degree of coincidence in distribution of agricultural uses of land with slope-soil-drainage complexes. Trans. Ill. State Acad. Sci. 22:549-554. (1929). [Adaptations of such methods for ecological and other survey will suggest themselves.]

JORDAN, EDWIN O.

1903 The self-purification of streams. Univ. Chicago, The Decennial Publs. 10:81-89. [Data from streams of the state, particularly Ill. River.]

JUDAY, C.

1914 The inland lakes of Wisconsin. The hydrography and morphometry of the lakes. Wis. Geol. and Nat. Hist. Surv. Bull. no. 27. 15 + 137 pp.

JURICA, H. S.

1926 Opportunities for field study in the Chicago area. Trans. Ill. State Acad. Sci. 18:184-192. (1925). [Maps of Cook and DuPage counties, with forest preserves; detailed map of Morton Arboretum.]

KARPINSKI, LOUIS C.

1931 Bibliography of the printed maps of Michigan, 1804-1880, . . . an historical atlas of the Great Lakes and Michigan. Mich. Historical Commission, Lansing. 539 pp. Many reproductions of old maps.

KAUFMANN, REBECCA

1922 (Article on White Pines Park.) See COWLES, SMITH, et al., 1922.

KAY, GEORGE F.

1916 Gumbotil, a new term in Pleistocene geology. Science 44:637-638.

1930 Contributions to the Pleistocene geology of Iowa. Proc. Iowa Acad. Sci. 36:35-44. (1929). [Review of progress in investigation, and changing conclusions as to relations and duration of glacial and interglacial epochs. Occurrence, thicknesses, and significance of the gumbotils of the 3 earlier drifts.]

1931 The relative ages of the Iowa and Wisconsin drift sheets. Am. Jour. Sci. 21:158-172. [Interval between Iowan and Wisconsin glacial ages was relatively short. These two, with the Peorian interglacial age, make up the Eldoran epoch. Map p. 159.]

1931 Classification and duration of the Pleistocene period. Bull. Geol. Soc. Am. 42:425-466. [Glacial chronology in Iowa. Pleistocene deposits represent work of 700,000 to a possible 2,000,000 years. Postglacial time 25,000. Times of glaciation a small fraction of interglacial time (30,000:675,000, or 1:22.5). Information graphically summarized in maps and diagrams.]

1932 Minimum durations of the glacial and interglacial ages in the Pleistocene of Iowa. (Abstract). Proc. Iowa Acad. Sci. 38:204-205. (1931).

KAY, G. F., AND APFEL, E. T.

1929 The pre-Illinoian Pleistocene geology of Iowa. Iowa Geol. Surv., Ann. Rept. 34:1-304. (1928). [Detailed presentation of data on the older drifts and their weathering; many photographs, diagrams, and maps. Chap. 2 is on topogr. and drainage of Iowa.]

KAY, G. F., AND PEARCE, J. N.

1920 The origin of gumbotil. Jour. Geol. 28:89-125.

KELLOGG, CHARLES E.

1930 Preliminary study of the profiles of the principal soil types of Wisconsin. Wis. Geol. and Nat. Hist. Surv., Bull. no. 77A, Soil Ser. no. 54. 112 pp.

KELLOGG, HARRIETTE S., AND PAMMEL, L. H.

1905 Partial bibliography pertaining to grasses. Supplementary Report Iowa Geological Survey 1903:407-423.

KELLOGG, R. S.

1904 Forest trees noted in northern and central Illinois. MSS. U. S. For. Serv.

1907 Forest planting in Illinois. Rept. Ill. Farmers' Inst. 12:232-244. [Mentions certain plantations, notably that of 1871-74 in Christian co. Ecol. results of plantations in indicating requirements of certain trees. Plan of mixed plantation at DeKalb, with triangular spacing.]

KELLY, H. M.

1899 A statistical study of the parasites of the Unionidae. Bull. Ill. State Lab. Nat. Hist. 5:399-418.

KENNICOTT, ROBERT

1855 Catalogue of animals observed in Cook county, Illinois. Trans. Ill. State Agr. Soc. 1:577-595. (1853-4). [Degree of abundance given, with occasional brief habitat or other notes, as that Cooper's hawks follow the pigeons in their migrations.]

1857 The quadrupeds of Illinois, injurious and beneficial to the farmer. Trans. Ill. State Agr. Soc. 2:615-684. (1856-57). "From the Patent Office Report." Plates with 20 woodcuts at end of vol. [Full accounts on habits, life-histories, habitats, relation to other animals and to vegetation. Incidental information on other topics, as increase of oaks in n. Ill., p. 622, prairie sloughs, in acct. of muskrat, p. 681.]

KENOYER, L. A.

1916 Environmental influences on nectar secretion. Iowa Agr. Exp. Sta., Res. Bull. 1916:217-232. (Res. Bull. no. 37).

KEYES, CHARLES R.

1896 Bibliography of Missouri geology. Repts. Mo. Geol. Surv. 10:219-523.

KING, CHARLOTTE M. See PAMMEL AND KING.

KING, INEZ N.

1915 The Coleoptera of Henry county, Iowa. Proc. Iowa Acad. Sci. 21:317-340. (1914).

KLAGES, K. H.

1930 Geographical distribution of variability in the yields of field crops in the states of the Mississippi valley. Ecology 11:293-306. [Ill. and other states e. of Miss. river less subject to fluctuations than states farther west.]

KNAPPEN, R. S.

1926 Geology and mineral resources of the Dixon quadrangle. Ill. State Geol. Surv. Bull. no. 49. 141 pp.

KOFOID, C. A.

1897-1908 Plankton studies. Bull. Ill. State Lab. Nat. Hist. 5: to 8: a total of 961 pp., with 65 pls.

1897 I. Methods and apparatus . . . 5:1-25.

1898 II. On Pleodorina illinoisensis, a new species from the plankton of the Illinois River. 5:273-293.

1899 III. On Platydorina, a new genus of the family Volvocidae . . . 5:419-440.

1903 IV. The plankton of the Illinois River, 1894-1899, with introductory notes on the hydrography of the Illinois River and its basin. Part I. Quantitative investigations and general results. 6:95-629.

1908 V. The plankton of the Illinois River, 1894-1899. Part II. Constituent organisms and their seasonal distribution. 8:3-360.

KOHL, EDWIN J.

1921 Mallophaga of our native birds. Proc. Ind. Acad. Sci. 1920:119-133.

KOMAREK, E. V., AND SPENCER, DON A.

1931 A new pocket gopher from Illinois and Indiana. Jour. Mammal. 12:404-498.

KUNERTH, WM., AND MILLER, RUSSEL D.

1931 Skyshine and sunshine at Ames. Proc. Iowa Acad. Sci. 37:303-305. (1930). [Determinations with Macbeth illuminometer.]

KURZ, HERMAN

1922 Hydrogen ion concentration in relation to topography, types and depths of soil, seasonal phenomena, and plant distribution. Ph.D. thesis, Univ. of Chicago.

1923 Hydrogen ion concentration in relation to ecological factors. Bot. Gaz. 76:1-29. Studies at Thornton, Palos Park, Apple River Canyon, Benton Mound, Starved Rock, Ill.; Chesterton bog and L. Mich. dunes, n. Ind.; Sawyer dunes and Baroda bog, s. w. Mich.

1928 Influence of sphagnum and other mosses on bog reactions. Ecology 9:56-69. [Lake co., Ill. (Sayer, Duck Lake, Wauconda, and Cedar Lake bogs; County Line tamarack forest). Indiana dunes (Cowles, Chesterton, and Merrillville bogs). Others in Mich. Classification of bogs, etc.]

LAMAR, J. E.

1925 Glacial phenomena in the vicinity of Carbondale. Trans. Ill. State Acad. Sci. 17:181-186. (1924). Map.

1925 Geology and mineral resources of the Carbondale quadrangle. Ill. State Geol. Surv. Bull. no. 48. 172 pp.

LAPHAM, I. A.

1853 The grasses of Wisconsin, and the adjacent states of Iowa, Illinois, Indiana, Ohio, and Michigan, the territory of Minnesota and the regions about Lake Superior. Trans. Wis. State Agric. Soc. 3:397-488. [149 spp. listed.]

1857 Catalogue of the plants of the State of Illinois. Trans. Ill. State Agr. Soc. 2:492-550. (1856-7). [Interesting quotations from SHORT, 1845, on pp. 492-494. The catalogue includes lists contributed by S. B. MEAD for Hancock co., and GEORGE ENGELMANN for so. Ill., mostly opposite St. Louis. Other collections by Ill. botanists were examined. No annotations, except N or S for plants found only in one end of the state.] Additions by BRENDEL, 3:583-585; by BEBB, 3:586-587. 1859; by VASEY, 4:667-671. 1861.

1857 The native, naturalized, and cultivated grasses of the State of Illinois. Trans. Ill. State Agr. Soc. 2:551-613. (1856-7). [Synonyms, descriptions, notes on mode of growth, time of flowering, distribution, habitat, etc. 4 pls. with many figs., index.]

LE BARON, WILLIAM

1855 Observations upon some of the birds of Illinois most interesting to the agriculturist. Trans. Ill. Agr. Soc. 1:559-565. (1853-4). "The Crow . . . is rare at the west. It is only occasionally that we see them, and then only in small companies of less than a dozen."

LEDGERWOOD, MARY

1931 The American bottom [Miss. floodplain on Ill. side, near St. Louis] and the characteristic plants of the region. Mo. Bot. Gard. Bull. 19:99-109.

LE FEVRE, GEORGE, AND CURTIS, W. C.

1908 Experiments in the artificial propagation of fresh-water mussels. Bull. U. S. Bur. Fish. 28:615-626.

LEIGHTON, M. M.

1916 Leaching of the Pleistocene drifts of eastern Iowa. Abstract. Proc. Iowa Acad. Sci. 22:19-20.

1923 The differentiation of the drift sheets of northwestern Illinois. Jour. Geol. 31:265-281.

1925 The glacial history of the Elgin region. Trans. Ill. State Acad. Sci. 17:65-71. (1924).

1930 Topographic and other maps of Illinois. The Ill. Engineer 6 (2):4-6.

1931 The Peorian loess and the classification of the glacial drift sheets of the Mississippi valley. Jour. Geol. 39:45-53. [Peorian time too brief for interglacial stage. Iowan regarded as earliest Wisconsin. Map, p. 52. Correlation of American and European classifications, p. 53.]

LEIGHTON, M. M., AND MacCLINTOCK, PAUL

1930 Weathered zones of the drift sheets of Illinois. Jour. Geol. 38:28-53. (Reprinted as Rept. of Investigations No. 20, Ill. State Geol. Surv. 1930.)

1930 Geological aspects of the genesis and morphology of Illinois soils. 2d Internat. Congr. Soil Sci. 5:97-111.

LEIGHTON, M. M., AND POWERS, W. E.

1934 Evaluation of boundaries in the mapping of glaciated areas. Jour. Geol. 47:77-87.

LESQUEREUX, LEO

1865 On the origin and formation of prairies. Am. Jour. Sci. and Arts 89 (2d ser. 39) :317-327; 90 (2d ser. 40) :23-31.

1866 On the origin and formation of the prairies. Geol. Surv. Ill. 1:238-254.

LEVERETT, FRANK

1888 Raised beaches of Lake Michigan. Trans. Wis. Acad. Sci. 7:177-192.

1895 Soils of Illinois. Pp. 73-92 of Final Rept. of Ill. Board of World's Fair Commissioners. Springfield.

1896 The Pleistocene features and deposits of the Chicago area. Chicago Acad. Sci., Bull. No. 2. 87 pp.

1896 Water resources of Illinois. U. S. Geol. Surv., Ann. Rept. 17, Part II: h, 695-849.

1899 The Illinois glacial lobe. U. S. Geol. Surv., Monograph 38. 817 pp.

1908 Glacial deposits of Indiana. Pp. 29-41 of DRYER, 1908, q.v.

1910 Outline of the history of the Great Lakes. Rept. Mich. Acad. Sci. 12:19-42.

1921 Outline of the Pleistocene history of the Mississippi Valley. Jour. Geol. 29:615-626.

LEVERETT, FRANK AND TAYLOR, F. B.

1915 The Pleistocene of Indiana and Michigan, and the history of the Great Lakes. U. S. Geol. Surv., Monograph 53. 529 pp.

LIEBTAG, CHARLOTTE E., AND McDOUGALL, W. B.

1929 Ecologic foliar anatomy of some plants common to Illinois and North Carolina. Trans. Ill. State Acad. Sci. 21:77-83. (1928).

LINDLY, J. M.

1905 Flowering plants of Henry county, Iowa. [I] Proc. Iowa Acad. Sci. 12:157. (1904).

1928 II. 34:133-137. (1927).

LINDSEY, ALVA J.

1932 The trees of Indiana in their local and general distribution according to physiographic divisions. Butler Univ. Bot. Studies 2:93-124.

LOBECK, A. K.

1929 [Physiographic diagram of Kentucky.] P. 332 of the geology and physiography of the Mammoth Cave National Park. Ky. Geol. Surv. ser. 6, 31:327-399. (Separate issued as Pamphlet 21, 1928.)

1930 The Midland Trail in Kentucky; a physiographic and geologic guide book to U. S. Highway no. 60. Ky. Geol. Surv., Ser. 6, 33;163-252. 39 photographs, maps, and diagrams.

LONGNECKER, KARL

1929 A study of the Coccinellidae of Iowa. Proc. Iowa Acad. Sci. 35:307-311. (1928).

LOUCKS, W. E.

1892 Birds of Peoria and Tazewell counties, Illinois. MS, typewritten, 23 pp. In Peoria Public Library. [Lists 163 spp.]

1893 Distribution of the bobolink in Illinois. Ornithologist and Oologist 18:52-56. Distr. of yellow-headed blackbird, 18:109-112.

1894 The life history and distribution of the prothonotary warbler in Illinois. Bull. Ill. State Lab. Nat. Hist. 4:10-35. See ADAMS 1902.

LOUGHRIDGE, ROBERT HILLS

1888 Report on geological and economic features of the Jackson Purchase region [w. end Ky.] Geol. Surv. Ky. (J. R. Procter, Director), [ser. 2], vol. F. 357 pp. [Soils, topogr. and veg. of different types of areas, pp. 139-172. Cane hills, see index. Conversion of grass barrens to scrub oak, 163-172. Notes on timber, etc., in county descriptions, 201-320.]

LUCE, W. M.

1933 A survey of the fishery of the Kaskaskia River. Ill. Nat. Hist. Surv. Bull. 20:71-123.

LULL, R. S.

1931 Memorial of Oliver Perry Hay. Bull. Geol. Soc. Am. 42:30-48. [Bibl. of Hay's writings, 1878-1930, on pp. 34-48. Early papers incl. ecol. notes on species and faunas; those of Ill. and Ind. well represented.]

LUNT, H. A.

1929 The vertical distribution of soil bases and acidity in some Illinois soils. Soil Sci. 28:137-176.

1931 The carbon-organic matter factor in forest soil humus. Soil Sci. 32:27-33.

LYON, M. W., JR.

1923 Notes on the mammals of the dune region of Porter county, Indiana. Proc. Ind. Acad. Sci. 1922:209-221.

1924 Some soil and water reactions in the dunes region of Porter county. Proc. Ind. Acad. Sci. 33:281-284. [H-ion determinations.]

1927 List of flowering plants and ferns in the Dunes State Park and vicinity, Porter county, Indiana. Am. Midland Nat. 10:245-295.

1930 Suppl. to the above. Ibid 12:33-43.

MACBRIDE, J. FRANCIS

1924 [Wild flower leaflets] published by Field Museum of Natural History, Chicago. Photographs mostly by L. W. BROWNELL. Botany Leaflet No. 7 Spring wild flowers. 32 pp.
No. 8 Spring and early summer wild flowers. 30 pp.
No. 9 Summer wild flowers. 30 pp.
No. 10 Autumn flowers and fruits. 29 pp.

MACBRIDE, THOMAS H.

1888 to 1896 The saprophytic fungi of eastern Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa 1:30-44; 181-195. (2d part, 1890).—[3d part.] The Polyporeae, Part II of Vol. 3:1-30. 1895.—[4th part.] The Puffballs, 4:33-66 (with NORRA ALLIN). 1896.

1891 1893 The Myxomycetes of eastern Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 2:99-162, 384-389 (2d part, 1893).

1895 Forest trees of Allamakee county, Iowa. Iowa Geol. Surv. 4:112-120 (3d Ann. Rept., 1894). [Primeval forest not dense. In 1835 "one could drive a wagon anywhere through the Iowa forest." Bur oak on xeric sides of hills. Annotated list of tree species.]

1895 Forest distribution in Iowa. Proc. Iowa Acad. Sci. 3:96-101.

MACCLINTOCK, PAUL

1929 Physiographic divisions of the area covered by the Illinoian drift-sheet in southern Illinois. Ill. Geol. Surv., Rept. of Investigations No. 19:6-25.

1929 Recent discoveries of pre-Illinoian drift in southern Illinois. Ill. Geol. Surv., Rept. of Investigations 19:27-57.

1933 Correlation of the pre-Illinoian drifts of Illinois, Jour. Geol. 41:710-722. [Nebraskan ice-sheet advanced from w., Kansan from n.e. Map of these two drifts in Ill.]

See also LEIGHTON and MACCLINTOCK.

MACDONALD, ROSE M. E.

1921 An analytic subject bibliography of the publications of the Bureau of Fisheries, 1871-1920. U. S. Bur. Fish., Doc. 899. 306 pp. [Includes many additional titles on aquatic life and conditions of Great Lakes and inland waters of Ill. and adjoining states.]

MALLOCH, JOHN R.

1915 The Chironomidae, or midges, of Illinois, with particular reference to the species occurring in the Illinois River. Bull. Ill. State Lab. Nat. Hist. 10:275-543 (additional records in 11:305-363. 1915.)

MALOTT, C. A.

1922 The physiography of Indiana. Part 2, Handbook of Indiana Geology. Ind. Dept. Conserv., Publ. 21:59-256. [Topographic map, pl. I; physiographic divisions, pl. II; glacial map, moraines, etc., pl. III.]

1926 The glacial boundary in Indiana. Proc. Ind. Acad. Sci. 35; 93-107. (1925).

MARBUT, CURTIS F.

1896 Physical features of Missouri. Repts. Mo. Geol. Surv. 10:11-109.

1923 Soils of the Great Plains. [Includes broader area eastward than the short-grass plains.] Ann. Assoc. Am. Geographers 13:41-66.

MARTIN, G. W.

1926 Some Amanitas from eastern Iowa. Proc. Iowa Acad. Sci. 32:205-213. (1925).

MARTIN, LAWRENCE

1914 The physical geography of Wisconsin. Jour. of Geogr. 12:226-232.

1932 The physical geography of Wisconsin, 2d ed. Wis. Geol. and Nat. Hist. Surv. Bull. No. 36 (Educ. Ser. No. 4). 608 pp. (Rev. of above and other articles on Wis. geography in Geogr. Rev. 23: 135-136. Map of Wis. showing 22 geographic districts on p. 135.) [1st ed. of MARTIN in 1916. On p. 16 of 2d ed., forest map of 1882 showing 4 groups of forest types. Prairies in Driftless Area, pp. 137-139; map, p. 138. Prairies in s. e. Wis., p. 291; map, p. 292. Map of swamps, p. 290. Glacial maps, p. 83, 87, etc. Bibl. of maps, pp. 494-513. Index map of soil survey, p. 512. Full bibl. at end of each chapter. Relief map in pocket.]

MASON, EDWARD GAY

1901 Chapters from Illinois history. Chicago, H. S. Stone and Co. 322 pp. [Incl.: The land of the Illinois, and Illinois in the eighteenth century.]

MATHER, IRVIN F.

1900 The making of Illinois. Chicago. A. Flanagan. 244 pp.

MATHER, STEPHEN T.

1917 Report on the proposed Sand Dunes National Park, Indiana. Dept. of the Interior, Nat. Park Serv., Washington. Govt. Printing Office. 113 pp.

MATSON, NEHEMIAH

1874 French and Indians of Illinois River. 2d ed. Princeton, Ill. 270 pp.

MATTOON, W. R., AND MILLER, R. B.

1927 Forest trees of Illinois: how to know them. Ill. Dept. of Conserv., and U. S. For. Serv. Springfield, Ill. 93 pp. 6 reprintings.

MAURY, SARAH WEBB

1910 Native trees of Kentucky. Ky. Fed. of Women's Clubs, Louisville. 140 pp.

McADAMS, WILLIAM

1882 [Description of Madison co.] Pp. 58-64 of History of Madison County, Ill. Edwardsville. W. R. Brink and Co., publishers. 603 pp.

McATEE, W. L.

1926 Notes on Homoptera from Illinois. Ill. State Nat. Hist. Surv. Bull. 16:127-136.

McBETH, WM. A.

1916 Loess and sand dune deposits in Vigo county, Indiana. Proc. Ind. Acad. Sci. 1915:185-188.

McDONALD, FRANK E.

1890 to 1918 [Unpublished book of notes on flora of Peoria district. Embodies his own field data and later observations of FREDERICK BRENDEL. In private library of V. H. Chase, Peoria. The period covered is an approximation only.]

1899 Geographical range of Asclepias meadii and Hypericum kalmianum. Plant World 2:126-127.

1900 A sand dune flora of central Illinois. Plant World 3:101-103. [Illinois river valley, Cass county.]

McDOUGALL, W. B.

1916 The growth of forest tree roots. Am. Jour. Bot. 3:384-392.

1920 Plant succession on an artificial bare area in Illinois. Trans. Ill. State Acad. Sci. 11:129-131. (1918).

1920 The forests of Vermilion county. Trans. Ill. State Acad. Sci. 12: 282-289. (1919).

1921 A comparison of soil temperatures in upland and bottomland forests. Trans. Ill. State Acad. Sci. 13:249-254. (1920).

1922 A preliminary key to some forest tree roots. Trans. Ill. State Acad. Sci. 14:87-91. (1921).

1922 Mycorhizas of coniferous trees. Jour. Forestry 20:255-260.

1922 Symbiosis in a deciduous forest. I. Bot. Gaz. 73:200-212.

1925 II. Bot. Gaz. 79:95-102.

1925 Forests and soils of Vermilion county, Illinois, with special reference to the "striplands". Ecology 6:372-379.

McDOUGALL, W. B., AND LIEBTAG, CHARLOTTE

1928 Symbiosis in a deciduous forest. III. Mycorhizal relations. Bot. Gaz. 86:226-234.

McDOUGALL, W. B., AND PENFOUND, W. T.

1928 Ecological anatomy of some deciduous forest plants. Ecology 9: 349-353.

McEATHRON, W. J., AND HIDINGER, L. L.

1911 Report upon the prevention of overflow of the Little Wabash and Skillet Fork Rivers. Rivers and Lakes Commission, State of Ill. Springfield. 39 pp., with separate atlas (5 profiles and 18 maps, folded, in case).

McGEE, W. J.

1891 The Pleistocene history of northeastern Iowa. U. S. Geol. Surv., Ann. Rept. 11, part 1:199-577. [22 pls., incl. map of forest and prairie districts.]

McLAUGHLIN, W. T.

1932 Atlantic coastal plain plants in the sand barrens of northwestern Wisconsin. Ecol. Monographs 2:335-383. [Important relation to flora of Lake Michigan strand, and Ill. and Ind. dunes and swales near south end of lake.]

McNEILL, JEROME

1891 A list of the Orthoptera of Illinois. Psyche 6:3-9, 21-27, 62-66, 73-78.

McNUTT, W., AND FULLER, G. D.

1913 The range of evaporation and soil moisture in the oak-hickory forest association of Illinois. Trans. Ill. (State) Acad. Sci. 5:127-137. (1912).

MEAD, S. B. See LAPHAM, 1857, and VASEY, 1861.

MEEHAN, THOMAS

1881 Treeless prairies. Bot. Gaz. 6:253-255. [Emphasizes fire in preventing encroachment of forest upon prairie.]

MEEK, S. E.

1889 The native fishes of Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 1:161-171.

MEEK, S. E., AND HILDEBRAND, S. F.

1910 A synoptic list of the fishes known to occur within fifty miles of Chicago. Field Mus. Nat. Hist., Zool. Ser. 7:223-338.

MICHAUX, ANDRÉ

See C. S. SARGENT, 1889, Portions of the journal of André Michaux. [The Flora Boreali-Americana, and the Sylva of N. Am. by the younger MICHAUX, are apparently of little value for distributional and habitat studies in Ill. The colored plates in the Sylva are of high quality and usefulness even as judged by present standards.]

MIDDLETON, A. R., JILLSON, W. R., McFARLAND, F. T., AND ANDERSON, W. A., JR.

1926 Kentucky. Pp. 349-354 of Naturalist's guide to the Americas. See SHELFORD 1926.

MILLER, ANGE V.

1885 General indexes to the first twelve reports [of the Illinois State Entomologist]. Appendix to 14th rept., 19 + 107 pp. Includes an index to food plants. [See HART and SNYDER, 1909; and FRISON and SNYDER, 1925.]

MILLER, ARTHUR M.

1919 The geology of Kentucky: a classified compend of State Reports and other publications, etc. Dept. of Geol. and Forestry Ky., Ser. 5, Bull No. 2. 392 pp. [Incl. "Physical regions of Ky.," "Natural features and phenomena of geologic and scenic interest," and extensive bibl.]

1927 Origin of the prairie. Science 66:655-656.

MILLER, ERIC R.

1917 The meteorological influences of lakes. Proc. 2d. Pan-Am. Sci. Congr. 2:189-198.

MILLER, JOHN T.

1931 Parent materials of Pike county, Indiana, soils. Proc. Ind. Acad. Sci. 40:235-236. (1930).

MILLER, M. F., AND KRUSEKOPF, H. H.

1929 The soils of Missouri. Univ. Mo. Agr. Exp. Sta. Bull. 264. 120 pp., with large folded soil map of entire state, in colors. [Topogr., p. 7; forests, 14; climate, 16; soils, soil profiles, and soil types by districts, 19-113. Maps: timber areas and forest types, p. 15; rainfall and temp., 16, 17; maps showing agricultural geography, pp. 115-120.]

MILLER, ROBERT B.

1923 First report on a forest survey of Illinois. Ill. State Nat. Hist. Surv. Bull. 14:291-377.

1926 Past and present interest in Illinois trees. Trans. Ill. State Acad. Sci. 18:193-202. (1925). [Quotations from MICHAUX, 1803, Flora Boreali-Americana; work of Ill. botanists.]

MILLER, R. B., AND FULLER, G. D.

1920 Strip survey and growth studies in LaSalle county, Illinois. Trans. Ill. State Acad. Sci. 12:273-281. (1919).

1922 Forest conditions in Alexander county, Illinois. Trans. Ill. State Acad. Sci. 14:92-108. (1921). [Geol. and geogr. papers on the Ozark Hills of Ill. in same vol.]

MILLER, R. B., AND TEHON, L. R.

1929 The native and naturalized trees of Illinois. Ill. State Nat. Hist. Surv. Bull. 18:1-339. [122 of the many figs. are full-page. For most spp. a small map is given showing which Ill. counties are represented by herbarium specimens or other authentic record. 94 tree spp. are given individual treatment. Other spp. and varieties mentioned (excl. oak hybrids) bring the list to 128.—Figs. 122 to 146 are photomicrographs of various woods in transverse section.]

See also CHAPMAN AND MILLER, FRISON AND MILLER, and MATTOON AND MILLER.

MILLS, HARLOW B.

1934 A monograph of the Collembola of Iowa. Collegiate Press, Ames. 11 + 143 pp.

MISSOURI SOIL SURVEY

[Index map on p. 11 of MILLER and KRUSEKOPF, 1929, q. v., showing counties of Missouri covered by detailed soil surveys to 1929. Those for Mississippi River counties opposite Illinois are, north to south: Marion, Ralls, Pike, Lincoln, St. Louis, Perry, Cape Girardeau, and Mississippi.]

MITCHELL, S. AUGUSTUS

1837 Illinois in 1837; a sketch descriptive of the . . . prominent districts, prairies, rivers, minerals, animals, . . . Philadelphia. 143 pp.

1838 Another edition: Illinois in 1837 and 1838 . . . "The publisher is probably the author. It was got up mainly to promote the sale of Illinois lands then owned by John Grigg of Philadelphia." —Sabin, Bibl. Amer. v. 9, no. 34260.

MOFFATT, WILL SAYER

1909 The higher fungi of the Chicago region. Part I.—The Hymenomycetes. Chicago Acad. Sci., Nat. Hist. Surv. Bull., no. 7, part 1. 156 pp.

1923 Part 2.—The Gastromycetes. Ibid. 24 pp.

MOHR, CARL

1932 Correlation of host plant and color pattern of *Rhodobaenus tredecimpunctatus* (Ill.) (Coleoptera, Rhyncophoridae). Trans. Ill. State Acad. Sci. 24:226-227. (1931).

MONTGOMERY, B. ELWOOD AND ROBERT W.

1931 Records of Indiana Coleoptera. I. Cicindelidae. Proc. Ind. Acad. Sci. 40:357-359. (1930).

MONTGOMERY, C. E.

1931 Ecology of the mosses of the Grand de Tour region of Illinois, with special reference to pH relations. Bot. Gaz. 91:225-251.

MONTGOMERY, ROBERT W.

1931 Preliminary list of the butterflies of Indiana. Proc. Ind. Acad. Sci. 40:351-355. (1930).

MOORE, J. PERCY

1901 The Hirudinea of Illinois. Bull. Ill. State Lab. Nat. Hist. 5:479-547.

MOSHER, EDNA

1916 The grass flora of Illinois. Trans. Ill. (State) Acad. Sci. 8:137-139. (1915).

1918 The grasses of Illinois. Univ. Ill. Agr. Exp. Sta. Bull., 15:257-425. (Bull. no. 205).

MOSIER, J. G.

1918 Climate of Illinois. Univ. Ill. Agr. Exp. Sta. Bull., 15:1-125 (no. 208). Also, Bull. No. 208—Abstract. 8 pp. 1918.

See also Illinois Soil Survey.

MUMFORD, H. W.

1934 The significance of the conservation of land resources. Trans. Ill. State Acad. Sci. 27:19-22. [Based upon and applicable to Ill. conditions.]

MURCHISON, A. C.

1893 Distribution of the mocking bird in Illinois. Ornithologist and Oologist 18:67-70. Similar papers dealing with long-eared owl and Cooper's hawk:17-22, 33-35, 49-51; with black-crowned night heron, 82-85.

MUSSELMAN, T. E.

1921 A history of the birds of Illinois. Jour. Ill. State Historical Soc. 14:1-75.

NAGEL, J. J., AND HAUPT, J. B.

1876 List of phaenogamous plants (in the vicinity of Davenport, Iowa, 1870-1875). Proc. Davenport Acad. Sci. 1:153-164.

NEEDHAM, J. G.

1900 Insect drift on the shore of Lake Michigan. Occas. Mem. Chicago Ent. Soc. 1 (1):19-26. [Infl. of storms in blowing insects into the lake, later drifting them ashore in windrows. Lake Bluff and Lake Forest, Ill. Analysis of insect drift.]

1904 Beetle drift on Lake Michigan. Can. Ent. 36:294-296. [Lake Forest, Ill. Lachnosterna (Phyllophaga) fusca in enormous numbers; other beetles, incl. many Calosoma frigidum.]

NEEDHAM, JAMES G. AND HART, CHARLES A.

1901 The dragon-flies (Odonata) of Illinois, with descriptions of the immature stages. Part I. Petaluridae, Aeschnidae, and Gomphidae. Bull. Ill. State Lab. Nat. Hist. 6:1-94.

NELSON, E. W.

1876 Birds of northeastern Illinois. Bull. Essex Inst. 8:90-155.

1876 Additions to the avifauna of Illinois with notes on other species of Illinois birds. Bull. Nutt. Orn. Club. 1:39-44.

1877 Notes upon birds observed in southern Illinois between July 17 and September 4, 1875. Bull. Essex Inst. 9:32-65.

NELSON, EDWARD W.

1878 Fisheries of Chicago and vicinity. (Containing lists of species taken at Chicago and fishing in adjacent waters; and species in the Illinois River in the vicinity of Peoria.) Ann. Rept. U. S. Commr. Fisheries 1875-1876:783-800.

NIPHER, FRANCIS E.

1890 Report on Missouri rainfall, with averages for ten years ending December, 1887. Trans. Acad. Sci. St. Louis. 5:383-433 (1888). [With maps showing normal rainfall for each month, each season, and the year.]

NOLAND, LOWELL E.

1925 Factors influencing the distribution of fresh water ciliates. Ecology 6:437-452. [Extensive collections and factor-determinations from a diversity of habitats in s. Wis. Data on 60 + spp. Full bibl.]

NORTON, ETHAN ARLO

1928 Profiles of soils in southern Illinois. Proc. and Papers 1st Internat. Congr. Soil Sci., Washington (1927), 4:283-290.

1934 Soil erosion map of Illinois. In SAWYER, L. E., 1934, Illinois' need for public ownership of forest lands. Centr. States Forestry Congr., Proc. 4th Ann. Conf. 1933:100-105. Springfield, Ill.

NORTON, E. A., AND BRAY, R. H.

1929 The soil reaction profile. Jour. Am. Soc. Agron. 21:834-844. [pH of A_1 horizon in Ill. soils approaches 5.7.]

NORTON, E. A., AND SMITH, R. S.

1927 Certain soil profiles in southern Illinois. Am. Soil Surv. Assoc. Bull. 8:21-27a.

1930 The influence of topography on soil profile character. Jour. Am. Soc. Agron. 22:251-262.

1932 The relationship between soil and native vegetation in Illinois. Trans. Ill. State Acad. Sci. 24:86-93. (1931). [Emphasizes poor drainage of flat prairie uplands as the controlling factor excluding forest.]

NORTON, E. A., AND WINTERS, ERIC

1930 Pedological aspects of the genesis and morphology of Illinois soils. 2d. Internat. Congr. Soil Sci. 5:91-96.

NORTON, J. B. S.

1897 The effects of wind on trees. Gard. and For. 10:292-293. [Tornado of 1896 at St. Louis. See VON SCHRENCK, 1898.]

OESTERLING, H. C. (EDITOR)

1931 Serial lists of publications of the Illinois State Natural History Survey, and its predecessors, the State Laboratory of Natural History, and the State Entomologist's Office. Urbana. 30 pp.

OSBORN, HERBERT

1892 On the orthopterous fauna of Iowa. Proc. Iowa Acad. Sci. 1 (part 2):116-120. (1890-1891).

OWEN, DAVID DALE

1840 [Descriptions of prairies.] In: Geological exploration of part of Iowa, Wisconsin, and Illinois. House Exec. Doc. 239, 26th Congr., 1st session. Washington. See township descriptions, pp. 70-115.

1856 [Remarks on the barrens of Kentucky.] Pp. 83-84 of Rept. Geol. Surv. Ky. for 1854 and 1855 [Ser. 1, vol. 1]. 416 pp., maps, etc. [Barrens considered not altogether attributable to fires, since these equally prevalent in well-timbered districts. Likely that some peculiarity of calcareous soil favored prior occupation by grasses.]

PACKARD, A. S., JR.

1873 On the cave fauna of Indiana. Peabody Acad. Sci., Ann. Rept. 5:93-97.

PAINTIN, RUTH D.

1929 The morphology and nature of a prairie in Cook county, Illinois. Trans. Ill. State Acad. Sci. 21:152-175. (1928).

PALMER, E. J.

1921 Botanical reconnaissance of southern Illinois. Jour. Arnold Arboret. 2:129-153. [Excellent concise account, with well annotated list of ligneous plants collected, pp. 138-153. 205 species, varieties and hybrids included.—"The topography of southern Illinois is remarkably varied."]

1921 The forest flora of the Ozark region. Jour. Arn. Arb. 2:216-232. [Mo., Ark., Okla. Includes good descriptions of naturally treeless openings: barrens, rock barrens, prairies, and rounded hill-tops or "bald knobs," pp. 223-226.]

1932 Notes on Ophioglossum engelmanni. Am. Fern Jour. 22:43-47.

PALMER, E. L.

1917 A seed key to some common weeds and plants. Proc. Iowa Acad. Sci. 23:335-394. (1916). [Descriptions, figures, bibl., index.]

PALMER, E. LAURENCE

1920 An ecological study of Dry Run, a typical prairie stream. I. The fishes. Proc. Iowa Acad. Sci. 26:111-124. (1919). [Tributary of Cedar River, Black Hawk co.]

PAMMEL, L. H.

1892 Windstorms and trees. Monthly Rev. Iowa Weather and Crop Service. 34:7.

1899 Some ecological notes on Iowa grasses. Proc. Soc. Promotion Agr. Sci. 1898:204-211. Reprint, Contr. Bot. Dept. Iowa State Coll. no. 12:204-211. Home Journal Print, LaFayette, Indiana.

1899 Some ecological notes on the Muscatine flora. Plant World 2:182-186. [Sand prairie, loess prairie, boreal survivals.]

1901 Some changed conditions of our flora incident to the settlement of the state [Iowa]. Proc. Soc. Promotion Agr. Sci. 1901:107-112.

1902 Ecological relations of plants. Iowa State Hort. Soc. Rept. 37:236-240.

1903 Ecology. Hungerford Press, Carroll, Iowa. 364 pp. ["A limited edition of this work was published in 1893 under the caption of 'Flower Ecology.'" Chapters 1 to 12 deal with pollination, its mechanisms and interrelations, etc. (to p. 230). Dispersal, adaptation, acclimatization and phenology, myrmecophytes, symbionts, are other subjects. Examples from Iowa and adjoining states are included. Figures largely by CHARLOTTE M. KING.]

1903 Some weeds of Iowa. Iowa Agr. Exp. Sta. Bull., 6:291-531. (Bull. no 70). [Includes many native plants. Distr. maps of certain spp.]

1905 Notes on some plants of northeastern Iowa. Plant World 8:31-35.

1905 A comparative study of the vegetation of swamp, clay and sandstone areas in western Wisconsin, southeastern Minnesota, northeastern, central and southeastern Iowa. Proc. Dav. Acad. Sci. 10:32-126.

1909 Flora of northern Iowa peat bogs. Iowa Geol. Surv., Ann. Rept. 19:737-777. (1908).

1913 The relation of ecology to agriculture. Proc. Soc. Promotion Agr. Sci. 1913:41-47.

1913 Weed migration. Iowa Geol. Surv. Bull., 4:685-769. (Revised ed., 4:576-614. 1926).

1917 The oaks. Trans. Iowa State Hort. Soc. 51:96-105, and 18 figs. (1916).

1920 The relation of native grasses to Puccinia graminis in the region of Iowa, western Illinois, Wisconsin, southern Minnesota and eastern South Dakota. Proc. Iowa Acad. Sci. 26:163-192. (1919).

1922 Trees of the proposed Mississippi Valley National Park; [and] Shrubs of the McGregor district. Proc. Iowa Acad. Sci. 28:264-267, 268-271. (1921). [These companion papers deal with n.e. Iowa and s.w. Wis.]

1924 The flora of Pine Hollow, Dubuque county, Iowa. Proc. Iowa Acad. Sci. 30:263-277. (1923). [See CONARD 1933.]

PAMMEL, L. H.—*Continued*

1925 A century of botany in Iowa. Proc. Iowa Acad. Sci. 31:45-68. (1924). [Mentions many articles, grouped by subjects, but does not attempt complete citations.]

1926 Notes on spear grass. Annals of Iowa, Ser. 3, 15:249-250.

1926 Iowa. Pp. 480-485 of Naturalist's guide to the Americas. See SHELFORD 1926.

See SHIMEK and KING, 1933 (Proc. Iowa Acad. Sci. 38:55-68) for account of life and writings of Dr. Pammel.

PAMMEL, L. H., AND DIEHL, W.

1918 The flora of Devil's Backbone. Iowa Conservationist 2:66-67.

PAMMEL, L. H., FORD, J. F., KELSO, J. AND HARLAN, E. R.

1920 Iowa parks. Conservation of Iowa historic, scenic, and scientific areas. Prepared by Iowa State Board of Conservation (names above). Published by the State of Iowa. Des Moines. 328 pp. Many figs. Index. (1919).

PAMMEL, L. H., AND KING, CHARLOTTE M.

1903 The vascular cryptogams of Iowa and the adjoining parts of southeastern Minnesota and western Wisconsin. Proc. Iowa Acad. Sci. 9:133-150, with 41 maps. (1902).

1904 The distribution of some Iowa plants; formations on which they occur. Science, n.s. 19:170.

1913 The general character of seeds. Iowa Geol. Surv., Bull., 4:405-502. (Rev. ed. 4:430-511, 1926.)

1918 The germination and juvenile forms of some oaks. Proc. Iowa Acad. Sci. 24:367-391. (1917). [One of a series of papers on germination and juvenile forms of mostly native plants. See bibl., Proc. Iowa Acad. Sci. 38:55-68.]

1924 The relation of honey plants to soils. Trans. Iowa State Hort. Soc. 58:391-406. (1923). [Special ref. to Iowa; citations of environmental factors in honey production.]

1926 Agencies of weed seed dissemination. Iowa Geol. Surv. Bull., Revised ed. 4:574-575.

PAMMEL, L. H., SEAL, J. L., AND DURRELL, L. W.

1916 Vegetation of Iowa lakes. State Highway Comm., Rept. on the Iowa lakes and lake beds, pp. 161-189.

PAMMEL, L. H., WEEMS, J. B., AND LAMSON-SCRIBNER, F.

1901 The grasses of Iowa. Iowa Geol. Surv., Bull. no. 1. 525 pp.

1901 Grasses of Iowa. Part I. Iowa Agr. Exp. Sta. Bull., 1901:61-342. (Bull. no. 54).

PAMMEL, L. H., BALL, CARLETON R., AND LAMSON-SCRIBNER, F.

1905 The grasses of Iowa. Part II. Supplementary Report, Iowa Geol. Surv., 1903:1-405.

PARK, ORLANDO

1929 Taxonomic studies in Coleoptera, with notes upon certain species of beetles in the Chicago area. I. Jour. N. Y. Ent. Soc. 37:429-436.

1929 Ecological observations upon the Myrmecocoles of Formica ulkei Emery, especially Leptinus testacus Mueller. Psyche 36:195-215.

PARK, ORLANDO—*Continued*

1929 Reticulitermes tibialis Banks in the Chicago area. Proc. Ent. Soc. Wash. 31:121-126. [A western sp. (one of many western organisms in dune areas of Ill. and Ind.) Here recorded from upper beach, Indiana dunes. Behavior, life-hist., etc.]

1930 Studies in the ecology of forest Coleoptera. [I.] Ann. Ent. Soc. Am. 23:57-80.

1931 Studies in the ecology of forest Coleoptera. II. Species associated with fungi in the Chicago area. Ecology 12:188-207.

1931 The measurement of daylight in the Chicago area and its ecological significance. Ecol. Monographs 1:189-230.

PARK, THOMAS

1929 Notes on the relationship between Formica ulkei Emery and Solenopsis molesta Say. Ent. News 60:325-326.

PARKMAN, FRANCIS

1905 LaSalle and the discovery of the Great West. 11th ed. Boston. Little, Brown, and Co. 25 + 483 pp. 2 maps.—1st ed. 1869: "The discovery of the Great West." 425 pp.

PARRISH, RANDALL

1906 Historic Illinois, the romance of the earlier days. Chicago. A. C. McClurg & Co. 3d ed. 479 pp.

PARVIN, J. B.

1855 On the habits of the gopher of Illinois (Geomys bursarius). Ann. Rept. Smithsonian Inst. 1854:293-294.

PATTERSON, HARRY N.

1876 Catalogue of the phaenogamous and vascular cryptogamous plants of Illinois, native and introduced. Oquawka, Ill.: Spectator Print. 54 pp.

PEARSE, A. S.

1921 The distribution and food of the fishes of three Wisconsin lakes in summer. Univ. Wis. Stud. Sci. 3:1-61.

1924 Amount of food eaten by four species of fresh-water fishes. Ecology 5:254-258.

1926 Wisconsin. Pp. 284-287 of Naturalist's guide to the Americas. See SHELFORD 1926.

1934 Ecology of lake fishes. Ecol. Monographs 4:475-480.

PEARSE, A. S., AND ACHTENBERG, H.

1920 Habits of yellow perch in Wisconsin lakes. Bull. U. S. Bur. Fish. 36:293-366.

PEARSON, JAY F. W.

1933 Studies on the ecological relations of bees in the Chicago region. Ecol. Monographs 3:373-441.

PEASE, THEODORE CALVIN

1919 The frontier state, 1818-1848. Centennial History of Ill., vol. 2. Springfield. 475 pp. See BUCK, S. J., 1917, and ALVORD, C. W., 1920.

PEATTIE, DONALD CULROSS

1922 The Atlantic coastal plain element in the flora of the Great Lakes. Rhodora 24:57-70, 80-88.

1925 Plants of Wolf Lake, Indiana-Illinois. Am. Bot. 31:99.

1930 Flora of the Indiana dunes. Handbook of the flowering plants and ferns of the Lake Michigan coast of Indiana and of the Calumet district. Field Mus. Nat. Hist., Chicago. 432 pp., folding map.

PECK, JOHN MASON

1834 A gazetteer of Illinois; in three parts: containing a general view of the state; a general view of each county; and a particular view of each town, settlement, stream, prairie, bottom, bluff, etc.—alphabetically arranged. Jacksonville. R. Goudy. 376 pp. (2d ed. rev., Philadelphia, Grigg & Elliott. 11 + 328 pp. 1837.)

1836 A new guide for emigrants to the west; containing sketches of Ohio, Indiana, Illinois, Missouri, and Michigan, with the territories of Wisconsin and Arkansas and the adjacent parts. Boston. Gould, Kendall & Lincoln. 374 pp.

1859 [Barrens of St. Clair co. in 1821.] Trans. Ill. State Agr. Soc. 3:407-412. (1857-8). "Timber stunted, shrubby, and scattering, with patches of prairie intermingled with patches of underbrush, of oak and hickory, growing from grub roots. On such tracts of new country the autumnal fires contend with the annual growth, and partially or wholly kill the young timber, until settlements are made, and the prairie grass killed out."

PEPOON, HERMAN S.

1904 The destruction of a farm flora. Plant World 7:44-45.

1909 An ecological survey of the driftless area of Illinois and Wisconsin. School Sci. and Math. 9:441-446; 522-527.

1910 The cliff flora of Jo Daviess County. Trans. Ill. State Acad. Sci. 2:32-37. (1909).

1911 The forest associations of northwestern Illinois. Trans. Ill. State Acad. Sci. 3:143-156. (1910).

1918 Peculiar plant distributions. Trans. Ill. [State] Acad. Sci. 9:128-137. (1916).

1918 The primrose rocks of Illinois. Trans. Ill. State Acad. Sci. 10:159-162. (1917).

1920 The forest lands of Jo Daviess County. Trans. Ill. State Acad. Sci. 12:183-202. (1919).

1922 [Article on Apple River Canyon, n. w. Ill.] See COWLES, SMITH, et al., 1922.

1927 An annotated flora of the Chicago region. Chicago Acad. Sci., Nat. Hist. Surv. Bull. no. 8. 554 pp. [Indispensable for Ill. studies of flora and vegetation.] See supplement by BUHL, 1934.

1928 The flora of the right of way of the Illinois Central Railway: Waddams to East Dubuque. Trans. Ill. State Acad. Sci. 20:92-98. (1927). 4 maps.

PERKINS, G. H.

1875 The vegetation of the Illinois lowlands. Am. Nat. 9:385-393. [Descriptions rather indefinite.]

PETERSEN, WALBURGA

1926 Seasonal succession in a Chara-cattail pond. Ecology 7:371-377. [Pond in L. Mich. dunes, n. w. Ind.]

PICKELS, G. W., AND LEONARD, F. B.

1921 Engineering and legal aspects of land drainage in Illinois. Ill. State Geol. Surv. Bull. no. 42. Revised ed. 1929. 334 pp., large folded drainage reclamation map in colors. [One sees from this how extensive the drainage operations over the flatter parts of Ill. have been, how great the change in environment resulting therefrom (cf. A. SAWYER, 1878), and how defective the original drainage of prairie uplands, cf. NORTON and SMITH, 1932.]

PHILLIPS, PHILIP LEE

1901 A list of maps of America in the library of Congress . . . Library of Congress, Washington, Govt. Printing Office. 1137 pp. [Illinois maps, 326-332; Indiana, 333-336; Iowa, 336-339; Kentucky, 349-353; Mississippi River, 437-442; Missouri, 442-445; Wisconsin, 1075-1082.]

1909 A list of geographical atlases in the Library of Congress, with bibliographical notes. Libr. of Congr., Washington. Vol. 1, Atlases. 13 + 1208 pp. (3265 atlases described). Vol. 2, Author list (pp. 1210-1313), and Index (pp. 1315-1659).

1914 Vol. 3. [Supplement to the above.] 137 + 1030 pp. Author list (pp. XI to CXXXVII), description of 822 additional atlases (pp. 1-692), and index (693-1030). [Illinois atlases, 1:804-816, 3:516-520.]

PINDAR, L. OTLEY

1889 List of the birds of Fulton County, Kentucky. The Auk 6:310-316. [181 native spp. listed, with brief notes.]

POGGI, E. MURIEL

1932 Settlement and development of the prairie province of Illinois. Trans. Ill. State Acad. Sci. 24:401-409. (1931).

1934 The Prairie Province of Illinois: a study of human adjustment to the natural environment. Ill. Studies in the Social Sciences 19 (3); Univ. of Ill. Bull. 31 (42). 124 pp., maps.

POOLEY, W. V.

1908 The settlement of Illinois from 1830 to 1850. Bull. Univ. Wis. Hist. Ser. 1:287-595.

POPE, T. E. B., AND DICKINSON, W. E.

1928 The amphibians and reptiles of Wisconsin. Bull. Publ. Mus. Milwaukee 8:1-138.

POTTER, GEORGE E. AND JONES, DAVID T.

1928 Compilation and revision of the fish records published for Iowa. Proc. Iowa Acad. Sci. 34:339-366. [Cites 26 papers containing records of Iowa fishes.]

POTZGER, J. E.

1932 Some observations on Pinus virginiana Mill. in Monroe county, Indiana, an ecological study. Proc. Ind. Acad. Sci. 41:153-174. (1931). [Rapid spread and establishment of new forest. All pines seeded from one parent tree planted about 60 years earlier.]

1933 (Grasses of Indiana). See DEAM, 1929.

POTZGER, J. E., AND FRIESNER, RAY C.

1934 Some comparisons between virgin forest and adjacent areas of secondary succession. Butler Univ. Bot. Studies 3:85-98. [Mauntel Woods, s. w. DuBois co., Ind.]

PRAIRIE CLUB OF CHICAGO

1915 Map of the Chicago region, 25 x 20 cm. 1.25 in. = 10 mi. Insert, 1915 Prairie Club Yearbook.

PRATTEN, HENRY

1855 Catalogue of south Illinois birds. Trans. Ill. Agr. Soc. 1:598-609. (1853-4). [Letters of transmittal, pp. 596-598: Pratten to J. G. Norwood to John A. Kennicott. Except for certain water birds from Ohio River, all records are for Wayne and Edwards counties. 184 spp. listed. Synonyms, but very little other information.]

PRESCOTT, G. W.

1928 A brief summary of work on Iowa algae. Proc. Iowa Acad. Sci. 34:111-113. (1927). [Bibl. of 16 titles.]

PRICE, GLADYS, AND WELCH, WINONA H.

1930 Enumeration of the vascular flora of a limestone area of the Bloomington quadrangle, Monroe county, Indiana. Proc. Ind. Acad. Sci. 39:127-131. (1929).

RADDIN, C. S.

1883 Catalogue of the phaenogamous plants of Evanston and vicinity, for 1883. Evanston, R. Vandercook. 26 pp. 706 spp. See also HIGLEY and RADDIN.

RAEDER, J. M.

1922 Studies of the phycomycetes of Iowa. Proc. Iowa Acad. Sci. 28: 283-291. (1921). [Records and notes of occurrence on particular hosts; host index, bibl.]

RAU, PHIL

1929 The habitat and dissemination of four species of Polistes wasps. Ecology 10:191-200. [They avoid competition by differentiation of nesting sites.]

RAU, PHIL AND NELLIE

1913 The biology of Stagmomantis carolina. Trans. Acad. Sci. St. Louis 22:1-58, and 18 pls.

RENSHAWE, G. H.

1924 Relief map of Kentucky. Ky. Geol. Surv. Frankfort.

REYNOLDS, JOHN

1855 My own times: embracing also the history of my life. [1st ed.] Belleville, Ill. 600 + 23 pp. 16mo.

1879 Reynolds' history of Illinois. My own times: etc. 2d ed. Chicago Historical Soc. 20 + 395 pp.

1887 The pioneer history of Illinois, 1673-1818. Chicago. Fergus Printing Co. 459 pp.

RHODES, J. W.

1933 An ecological comparison of two Wisconsin peat bogs. Bull. Publ. Mus. Milwaukee 7:305-362.

RICHARDSON, R. E.

1904 A review of the sunfishes of the current genera Apomotis, Lepomis, and Eupomotis, with particular reference to the species found in Illinois. Bull. Ill. State Lab. Nat. Hist. 7:27-35.

1913 Observations on the breeding habits of fishes at Havana, Illinois, 1910 and 1911. Bull. Ill. State Lab. Nat. Hist. 9:405-416.

1921 The small bottom and shore fauna of the middle and lower Illinois River and its connecting lakes, Chillicothe to Grafton; its valuation; its sources of food supply; and its relation to the fishery. Ill. State Nat. Hist. Surv. Bull. 13:363-522.—Review by F. C. BAKER in Ecology 5:416-418. 1923.

1928. The bottom fauna of the middle Illinois River, 1913-1925: Its distribution, abundance, valuation, and index value in the study of stream pollution. Ill. State Nat. Hist. Surv. Bull. 17:391-472.

1930 Notes on the simulation of natural aquatic conditions in fresh water by the use of small non-circulating balanced aquaria. Ecology 11:102-109. [Work done on Cook's Slough on Ill. river near Havana. Surface area requirements for fishes, plants for aquaria, etc.]

See also FORBES and RICHARDSON—1905, 1909, 1913, and 1919.

RIDDELL, JOHN L.

1835 Synopsis of the flora of the western states. Western Jour. of Med. and Physical Sciences. 7:329-374, 489-586. "Intended to cover Ohio, Ind., Ill., W. Tenn., Mo., and N. W. Territories." [Quoted from STANLEY COULTER, 1900.]

RIDGLEY, DOUGLAS C.

1921 The geography of Illinois. Univ. of Chicago Press. 385 pp. Many figs. and maps. Gen. refs. to study of geogr. of Ill., pp. 363-370.

RIDGWAY, ROBERT

1872 Notes on the vegetation of the lower Wabash Valley. I. Am. Nat. 6:658-665.

1872 II. Peculiar features of the bottom lands. 6:724-732.

1873 III. The woods and prairies of the upland portions. 7:154-157. [II mentions cypress swamps of Knox Co., Ind.; III: prairies, oak openings, and barrens, also prairie groves of pin oak and shingle oak.]

1873 The prairie birds of southern Illinois. Am. Nat. 7:197-203. [Fox prairie, 4 mi. w. of Olney.]

1874 The lower Wabash Valley, considered in its relation to the faunal districts of the eastern region of North America, with a synopsis of its avian fauna. Proc. Bost. Nat. Hist. Soc. 16:304-332.

1874 Catalogue of the birds ascertained to occur in Illinois. Ann. Lyc. Nat. Hist. N. Y. 10:364-394.

1875 Our native trees. The tulip tree—Liriodendron tulipifera. Field and Forest 1:49-53. [Data on its occurrence and size in lower Wabash valley.] (In Dec. no., 1875. Vol. completed Feb. 1876.)

RIDGWAY, ROBERT—*Continued*

1876 Notes on the catalpa. Catalpa bignonioides. Field and Forest 2:27-29. [Native trees and groves as far north as near Mt. Carmel, Ill., and in s. w. Ind.]

1876 The Little Cypress Swamp of Indiana. Field and Forest 2:93-96. [Part of the Knox co. cypress area of 20,000 acres. Tree and smaller-plant associates. Cane (Arundinaria). Growing-together of tree-trunks, in one case of 5 spp.]

1878 Notes on birds observed at Mt. Carmel, southern Illinois, in the spring of 1878. Bull. Nuttall Orn. Club 3:162-166.

1881 A revised catalogue of the birds ascertained to occur in Illinois. Bull. Ill. State Lab. Nat. Hist. 1 (4): 163-208.

1882 Native trees of the lower Wabash in Illinois and Indiana. Bot. Gaz. 7:102-103.

1882 Notes on the native trees of the lower Wabash and White River valleys, in Illinois and Indiana. Proc. U. S. Nat. Mus. 5:49-88. (Separate issued 1882; vol., 1883.)

1883 Additions and corrections to the list of native trees of the Lower Wabash Valley. Bot. Gaz. 8:345-352.

1889 The ornithology of Illinois. Part I. Descriptive catalogue. Final reports on the Nat. Hist. of Ill. 1: 520 pp., 33 pls.

1895 2: 282 pp., 33 pls.

1894 Additional notes on the native trees of the lower Wabash Valley. Proc. U. S. Nat. Mus. 17:409-421, with plates 10-15. (Separate was issued in 1894, vol. in 1895.)

1928 The ligneous flora of Richland County, Illinois. Trans. Ill. State Acad. Sci. 20:105-115. (1927).

RILEY, CHARLES V.

1868 The twig-girdler, Oncideres cingulatus, Say). Am. Ent. 1:76-77. Also 3: (new ser. 1:) 297. 1880. [Injures hickory, persimmon, pear, apple.—Its effects conspicuous today on persimmon in s. Ill. and s. Mo.—A. G. V.]

ROBERTSON, CHARLES

1887 Insect relations of certain Asclepiads. Bot. Gaz. 12:207-216, 244-250. [This and the many following papers are based on observations in Macoupin Co., Illinois, especially the vicinity of Carlinville.]

1889 to 1899 Flowers and insects. Series in Bot. Gaz. [Includes descriptions of insects' activities, etc.]

1889	I.	14:120-126.		XI.	18:267-274.
	II.	14:172-178.	1894	XII.	19:103-112.
	III.	14:297-304.	1895	XIII.	20:104-110.
1890	IV.	15:79-84.		XIV.	20:139-149.
	V.	15:199-204.	1896	XV.	21:72-81.
1891	VI.	16:65-71.		XVI.	21:266-274.
1892	VII.	17:65-71.		XVII.	22:154-165.
	VIII.	17:173-179.	1898	XVIII.	25:229-245.
	IX.	17:267-274.	1899	XIX.	28:27-45.
1893	X.	18:47-54.			

ROBERTSON, CHARLES—*Continued*

1890 to 1896 Flowers and insects. Series in Trans. Acad. Sci. St. Louis. [Supplements the series in Bot. Gaz., 1889 to 1899.]

1890 5:449-460. Umbelliferae.

1891 5:569-598. Asclepiadaceae to Scrophulariaceae.

1892 6:101-131. Labiatae.

1894 6:435-480. Rosaceae and Compositae.

1896 7:151-179. Contributions to an account of the ecological relations of the entomophilous flora and the anthophilous insect fauna of the neighborhood of Carlinville, Illinois.

1895 The philosophy of flower seasons, and the phaenological relations of the entomophilous flora and the anthophilous insect fauna. Am. Nat. 29:97-117. [In part a discussion of article by H. L. CLARKE, Am. Nat. 27:769-781. 1893. Robertson's data from Carlinville.—An incidental foot-note: "In the interaction of organisms . . . a law of avoidance of competition is more obvious than that of the survival of the fittest."]

1899 to 1901 Flower visits of oligotropic bees. Series in Bot. Gaz. First article, 28:215. 1899.—"Another note on the . . ." 30:130. 1900.—III. 32:367-368. 1901. [See also Fls. and Insects XIX, Bot. Gaz. 28:27-45.—Oligotropic = confining visits to a few similar or related fls.]

1906 Ecological adaptation and ecological selection. Science 23:307-310. [General conclusions of great significance in relations between environment and evolution, based on work at Carlinville. Suggests ecological basis for morphology and for evolution. See 1924 article in Science.]

1910 Hosts of Strepsiptera. Can. Ent. 42:323-330. [List of bees on which Stylops parasites were found.]

1914 Origin of oligotropy of bees. Ent. News 25:67-73.

1917 to 1923 Flowers and insects. Later series in Bot. Gaz. [These articles are not mentioned in bibl. of 1929 vol.]

1917	XX.	63:307-316.
1922	XXI.	73:148-152.
1923	XXII.	75:60-74.
1924	XXIII.	78:68-84.

1918 Proterandry and flight of bees. Ent. News 29:340-342. [Male bees of many spp. appear earlier than females, which live for a considerable time after males disappear.]

1922 The sunflower and its insect visitors. Ecology 3:17-21.

1922 Synopsis of Panurgidae. Psyche 29:159-173. [Includes seasonal data and list of flowers visited by each bee species.]

1922 Flower seasons. Sci. Monthly 14:201-203.

1923 Flower visits of insects. [I.] Psyche 30:158-169.

1924 II. Psyche 31:93-111.

1924. Conditions of natural selection. Science 59:363-364. ["Natural selection is an ecological theory. Diversifications of food habits and of geographical and phenological ranges are its most important conditions."—"Species . . . separated first and got their differences afterwards."—See 1906 article in Science.]

ROBERTSON, CHARLES—*Continued*

1924 Phenology of entomophilous flowers. Ecology 5:393-407.

1925 Heterotropic bees. Ecology 6:412-436. [Differentiation as to flowers visited, among bees of similar adaptation to flowers. For correction to list of oligolectic bees, see Ecology 7:378-380.]

1926 Revised list of oligolectic bees. Ecology 7:378-380. [Orig. list in Ecology 6:426-427. Oligolectic = restricted to a limited group of related flower species, from which pollen is collected.]

1927 Flowers and insects, XXIV. Ecology 8:113-132.

1928 Flowers and insects, XXV. Ecology 9:505-526. [These not mentioned in 1929 vol. XXV is in part a criticism of CLEMENTS and LONG, 1923, Experimental pollination. Carn. Inst. Publ. 336.]

1929 Flowers and insects: Lists of visitors of four hundred and fifty-three flowers. Publ. by the author, Carlinville, Ill. Science Press Printing Co., Lancaster, Pa. 221 pp. (1928). [List of insects, pp. 8-20. Visitors of particular fls., 20-221. Fls. arr. alphabetically by families. Blooming dates for each sp. Visitors arr, under each fl. sp. by groups, e. g. long-tongued bees, short-tongued bees, other Hymenoptera, Diptera, etc. Extremely concise; character of visits is shown by abbreviations. Observations made within ten miles of Carlinville. The work is incidentally a catalogue of plants and insects of a local district in s. w. Ill.]

ROBERTSON, INA C.

1928 The Ozark orchard center of southern Illinois. Econ. Geogr. 4:253-266.

ROE, E. R.

1859 Notes on the great drouth in '53 and '54. Trans. Ill. State Agr. Soc. 3:680-681. (1857-8). [Read before Ill. State Nat. Hist. Soc., 1859. Evidence of molluscs that prairie ponds which dried up in this drouth had not done so before.]

ROLFE, DEETTE

1929 The Rock River country of northern Illinois. Ill. State Geol. Surv., No. 2 of Educational Series. 59 pp.

ROSS, H. H.

1931 Sawflies of the sub-family Dolerinae of America north of Mexico. Ill. Biol. Mon. 12(3):205-320. (1929). [Biol., life-hist., seasonal and habitat relations in Ill., pp. 217-223.] (Separate paged 1-115).

1934 [Chapters in HEBARD, 1934, q. v.]

RUFFIN, EDMUND

1835 Inquiry into the causes of the existence of prairies, savannas, and deserts; and the peculiar constitutions of soils which either favor or prevent the destruction of the growth of forests. Farmer's Register (orig. place of publication, fide Dr. H. J. Lutz.) Also in the following book, pp. 213-273:

1855 Essays and notes on agriculture. Publ. by J. W. Randolph, Richmond, Va. 8 + 407 pp.

RUSSELL, J. C., AND ENGLE, E. G.

1925 Soil horizons in the central prairies. Am. Soil Surv. Assoc. Bull. 6:1-18.

RUTHVEN, A. G.

1908 The faunal affinities of the prairie region of central North America. Am. Nat. 42:388-393.

RYDBERG, P. A.

1931 Taxonomic notes on the flora of the prairies and plains of central North America. Brittonia 1:79-104.

SALISBURY, ROLLIN D., AND ALDEN, WM. C.

1899 The geography of Chicago and its environs. Geogr. Soc. of Chicago. Bull. no. 1, 64 pp. Revised ed., 1920. 63 pp.

SALISBURY, R. D., AND BARROWS, H. H.

1918 The environment of Camp Grant. Ill. State Geol. Surv. Bull. no. 39. 75 pp.

SAMPSON, F. A.

1913 A preliminary list of the Mollusca of Missouri (exclusive of the Unionidae). Trans. Acad. Sci. St. Louis 22:67-108.

SAMPSON, HOMER C.

1921 An ecological survey of the prairie vegetation of Illinois. Ill. State Nat. Hist. Surv. Bull. 13:523-577. Preliminary report in Trans. Ill. State Acad. Sci. 9:123-125. (1916). 1918. [Gives location of a number of areas remaining in 1920 with native prairie vegetation.]

SANBORN, COLIN C.

1922 Chicago winter birds. Field Mus. Nat. Hist., Zool. Lflt. no. 2. 12 pp.

1925 The mammals of the Chicago area. Ibid. no. 8. 21 pp.

SANDERS, NELL JACKSON, AND SHELFORD, V. E.

1922 A quantitative and seasonal study of a pine-dune animal community. Ecology 3:306-320. In L. Mich. dunes of n. w. Ind.

SARGENT, CHARLES SPRAGUE

1889 Portions of the journal of André Michaux, botanist, written during his travels in the United States and Canada, 1785 to 1796. With an introduction and explanatory notes. Proc. Am. Phil. Soc. 26:1-145. [Pp. 120-128: "Cahier 9. 1795 et 1796." In Aug. 1795, from Ohio River up the Wabash to Vincennes; Aug. 23-30, across Illinois to Kaskaskia; Sept. 5 and 6 to Prairie du Rocher and Kaskia, 8 and 9 return to Kaskaskia. Oct. 2, toward mouth of Ohio River. Oct. 5 "passè encore les Prairies entrecoupèes de lisières de Bois. Mon guide tua un Elk nommé . . . Illinois Cerf." Oct. 8, arrived at Fort Cheroquis or Fort Massac. (On pp. 124 and 125, notes on trees, etc. along Miss. and Ohio Rivers.) Later he returned to Kaskaskia, Fort Chartres, and Prairie du Rocher. He started his return from s. Ill. Dec. 14, 1795.]

1895 The forests of the Wabash valley. Gard. & For. 8:101-102.

1897 Notes on cultivated conifers.—III. Juniperus. Gard. and For. 10:410-411. (J. communis in America: ". . . it is only on the bold and broken summits . . . in one district of southern Illinois that this Juniper attains the habit and size of a small tree . . .")

SARGENT, WINTHROP

1793 Lists of forest and other trees northwest of the river Ohio to the 38th parallel. Am. Acad. of Arts and Sci., Mem. 2:156-159.

SAUER, CARL O.

1916 Geography of the upper Illinois valley and history of development. Ill. State Geol. Surv. Bull. No. 27. 208 pp.

1920 . . . The geography of the Ozark highland of Missouri . . . Univ. of Chicago Press. 18 + 245 pp., maps, pls.

SAUER, C. O., AND OTHERS

1927 Geography of the Pennyroyal [Mississippian Plateau, w. Ky.] Geol. Surv. Ky., Ser. 6, Vol. 25. 303 pp., many maps. [The Barrens (prairie), causes of treelessness, pp. 123-130.]

SAUER, C. O., CADY, G. H., AND COWLES, H. C.

1918 Starved Rock State Park and its environs. Geog. Soc. Chicago, Bull. 6. 148 pp.

SAVAGE, T. E.

1916 The loess in Illinois: its origin and age. Trans. Ill. (State) Acad. Sci. 8:100-117.

1921 Geology and mineral resources of the Avon and Canton quadrangles. Ill. State Geol. Surv. Bull. No. 38B. 68 pp. (38:211-271. 1922).

SAVAGE, T. E., AND NEBEL, E. L.

1921 Geology and mineral resources of the LaHarpe and Good Hope quadrangles. Ill. State Geol. Surv. Bull. No. 43A. 89 pp. (43:9-93. 1923).

SAVAGE, T. E., AND UDDEN, J. A.

1921 Geology and mineral resources of the Edgington and Milan quadrangles. Ill. State Geol. Surv. Bull. No. 38C. 96 pp. (38:115-208. 1922).

SAWYER, AMOS

1878 On climatic change in Illinois—its cause. Trans. Acad. Sci. St. Louis 3:255-260. (1868-1877). [Chiefly attributed to more rapid drainage, by natural extension of streams, also artificial drainage. Increase of domestic animals a second factor.]

SAWYER, L. E.

1931 Aims and purposes of forestry extension in Illinois. Trans. Ill. State Acad. Sci. 23:180-184. (1930). [Mention of growth of volunteer pin oak of 3 to 8 inch diam. in 15 years in an abandoned field, Crawford co.] See also NORTON, E. A., 1934.

SAYLES, ROBERT W.

1931 Bermuda during the Ice Age. Proc. Am. Acad. Arts and Sci. 66:379-466. [Glacial chronology, with estimates of relative and absolute duration of successive stages, and comparison with estimates of KAY, 1931, for Iowa.]

SCHAFFNER, J. H.

1926 Observations on the grasslands of the central United States. Ohio State Univ. Studies, Contrib. in Bot. No. 178:1-56. [Ill. prairie, pp. 9-10.]

SCHANTZ, ORPHEUS

1919 Indiana's unrivaled sand dunes—a national park opportunity. Nat. Geogr. Mag. 35:430-441. (May no.)

1928 Birds of Illinois. State Dept. of Conservation, Publ. no. 6. 130 pp. [Popular treatment. Life-zone map: Lower Austral with three subdivisions.]

SCHMIDT, KARL P.

1929 The frogs and toads of the Chicago area. Field Mus. Nat. Hist., Zool. Lflt. no. 11. 15 pp.

1930 The salamanders of the Chicago area. Ibid., no. 12. 17 pp.

SCHMOLL, HAZEL M.

1920 Ecological survey of forests in the vicinity of Glencoe, Illinois. Trans. Ill. State Acad. Sci. 12:208-233. (1919).

SCHNECK, J.

1876 Catalogue of the flora of the Wabash valley below the mouth of White River, and observations thereon. Geol. Surv. Ind., Ann. Rept. 7:504-579. Supplemented by list of 26 additional spp. in Bot. Gaz. 2:83. 1877. [Incl. 4 Ill. counties. Field study mostly in Gibson and Posey counties, Ind., and Wabash co., Ill. 867 spp. listed.]

1884 Notes on Phoradendron flavescens, Nutt. Bot. Gaz. 9:94-96, 101-103. Additional note, 15:211. 1890. [Life-history, distribution, hosts, extension northward set back by cold winters.]

1892 Notes on the hardwood trees of Illinois. Hardwood 2: nos. 1, 4, 5.

1903 The cross-bearing Bignonia or Cross vine. Plant World 6:157-159.

SCHOCKEL, B. H.

1916 History of development of Jo Daviess County. Ill. State Geol. Surv. Bull. 26:173-228. (Chap. 10 of TROWBRIDGE, SHAW, and SCHOCKEL). [Historic references include other parts of Ill.]

SCHULTZ, CHRISTIAN, JR.

1838 Sketches of Illinois, descriptive of its principal geographical features, prominent districts, prairies, etc. Philadelphia. 321 pp., 1 map.

SCHOEWE, W. H.

1920 The interpretation of certain leached gravel deposits in Louisa and Washington counties, Iowa. Proc. Iowa Acad. Sci. 26:393-398. (1919).

SCHWARZ, G. F.

1903 The diminished flow of the Rock River in Wisconsin and Illinois. Bur. of Forestry, U. S. Dept. Agr. Bull. 44.

SCOTT, WILL

1916 Report on the lakes of the Tippecanoe basin (Indiana). Ind. Univ. Studies no. 31. 39 pp.

1926 Indiana. Pp. 372-377 of Naturalist's guide to the Americas. See SHELFORD 1926.

SERVICE, C. M.

1920 Parks and memorials of the State of Illinois. Dept. of Public Works and Bldgs. Springfield. 52 pp.

1925 Later ed. Freeport. 64 pp. See ILL. BOARD OF PARK ADVISORS, 1933.

SEAVER, FRED J.

1904 The Discomycetes of eastern Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 5:230-297, with 25 pls.

SELLIER, L. M.

1924 Geographic map of Kentucky. Ky. Geol. Surv., Frankfort.

SHACKLEFORD, MARTHA W.

1929 Animal communities of an Illinois prairie. Ecol. 10:126-154.

SHALER, N. S., AND OTHERS

1884 Timber and botany [of Ky.]. Comprising seven reports [from earlier volumes] on the forests and botany of different parts of the state. Geol. Surv. Ky., New Ser. [2], 2d ed. [rearranged, related subjects together], vol. B. 239 pp. [Index, pp. 233-239; diagram of topogr. arrangement of forest belts on hills, pp. 26, 74.]

SHANNON, W. P.

1895 The range of the blue ash, Fraxinus quadrangulata. Proc. Ind. Acad. Sci. 1894:107-108.

SHAW, E. W.

1911 The infertility of southern Illinois. (Abstract). Ann. Assoc. Am. Geogr. 1:137.

1911 New system of quaternary lakes in the Mississippi basin. Jour. Geol. 19:481-491.

1915 Newly discovered beds of extinct lakes in southern and western Illinois and adjacent states. In Yearbook: Ill. State Geol. Surv. Bull no. 20:141-157.

SHAW, JAMES

1861 The great tornado of 1860. Trans. Ill. State Agr. Soc. 4:565-580. (1859-60). [Across n. Ill.]

1873 [Prairies of northwestern Illinois.] Geol. Surv. Ill. 5:11-14 (origin of prairie), 96, 134 (succession: marsh to low prairie), 140, 144, 185, 202.

1873 [Isolated groves of northwestern Illinois.] Geol. Surv. Ill. 5:56, 59, 82, 106, 125, 140, 166, 186. [Particular mention or brief description, in reports on different counties.]

1873 [Timbered or brushy "barrens" of northwestern Illinois.] Geol. Surv. Ill. 5:59, 82, 83, 95, 106, 140, 185.

SHEAR, G. M., AND STEWART, W. D.

1934 Moisture and pH studies of the soil under forest trees. Ecology 15:145-153. [Univ. of Ill. forest plantation.]

SHELFORD, V. E.

1909 Life histories and larval habits of the tiger beetles (Cicindelidae). Jour. Linn. Soc. Lond.—Zool. 30:157-184. 4 pls.

1911 Physiological animal geography. Jour. Morphol. 22:551-618.

SHELFORD, V. E.—*Continued*

1911 Ecological succession. Biol. Bull. I, 21:9-35; II, 21:127-151.
1912 III, 22:1-38; IV, 23:59-99; V, 331-370.

1913 The reaction of certain animals to gradients of evaporating power of air. Biol. Bull. 25:79-120.

1913 Animal communities in temperate America. Bull. Geogr. Soc. Chicago No. 5, publ. for the Society by Univ. of Chicago Press. 362 pp.

1914 An experimental study of the behavior agreement among the animals of an animal community. Biol. Bull. 26:295-315. Résumé in Trans. Ill. State Acad. Sci. 7:79-81.

1915 The original habitat and distribution of our native insect pests. Jour. Econ. Ent. 8:171-174.

1918 Physiological problems in the life histories of animals with particular reference to their seasonal appearance. Am. Nat. 52:129-154.

1927 An experimental investigation of the relations of the codling moth to weather and climate. Ill. State Nat. Hist. Surv. Bull. 16:311-440.

1929 Laboratory and field ecology. Williams and Wilkins Co., Baltimore. 608 pp.

1932 An experimental and observational study of the chinch bug in relation to climate and weather. Ill. Nat. Hist. Surv. Bull. 19:487-547.

Other articles by Shelford, involving organisms occurring in Illinois, are cited in his papers here listed.

SHEPHERD, FREDERICK

1932 The story of the dunes. Rocks and Minerals 7:41-48.

SHERFF, E. E.

1912 The vegetation of Skokie Marsh, with special reference to subterranean organs and their interrelationships. Bot. Gaz. 53:415-435. (Brief account in Trans. Ill. Acad. Sci. 5:125-127. 1913.)

1913 Vegetation of Skokie Marsh. Bull. Ill. State Lab. Nat. Hist. 9:575-614.

1913 Evaporation conditions at Skokie Marsh. Plant World 16:154-160.

SHIMEK, B.

1888 The Mollusca of eastern Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 1:56-81.

1896 Notes on the flora of Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 3:195-215.

1900 The distribution of forest trees in Iowa. Proc. Iowa Acad. Sci. 7:47-59, with map. (1899). [Most thorough discussion of prairie-forest relations. Many citations of infl. of fire, wind, soil, drainage, etc. Incl. discussion of topogr., exposure, and location as determinants of forest distr.]

1900 Iowa pteridophytes. Bull. Lab. Nat. Hist. Univ. Iowa 5:145-170.

1903 Iowa oaks. Trans. Iowa State Hort. Soc. 37:228-232, and 10 figs. (1902).

SHIMEK, B.—*Continued*

1904 Loess and the Iowan drift. Bull. Lab. Nat. Hist. Univ. Iowa 5:352-368.

1904 Evidences(?) of water-deposition of loess. Bull. Lab. Nat. Hist. Univ. Iowa 5:369-381.

1904 The native shrubs of Iowa. Trans. Iowa State Hort. Soc. 38:453-468, and 10 figs. (1903).

1904 The flora of the St. Peter sandstone in Winneshiek County, Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 5:225-229.

1908 The genesis of loess a problem in plant ecology. Proc. Iowa Acad. Sci. 15:57-75. (1908).

1910 Prairie openings in forests. Proc. Iowa Acad. Sci. 17:16-19. (1910).

1911 The prairies. Bull. Lab. Nat. Hist. Univ. Iowa 6:167-240. 13 pls., 1 map. [Includes bibl. of papers on origin of prairie, with brief summary of causes ascribed by the authors, pp. 231-239. Refs. pertaining directly to Ill. are included here. Shimek's other refs. to prairie are on pp. 239-240. His own discussion of causes of treelessness permeates the article.]

1912 The significance of Pleistocene mollusks. Science 37:501-509.

1913 An artificial prairie. Bull. Lab. Nat. Hist. Univ. Iowa 6 (no. 4): 35-41.

1918 The sand flora of Iowa. Bull. Lab. Nat. Hist. Univ. Iowa 7 (no. 3): 6-24.

1925 Drainage in Iowa. Proc. Iowa Acad. Sci. 31:149-155. (1924).

1925 The prairie of the Mississippi River bluffs. Proc. Iowa Acad. Sci. 31:205-211. (1924). [McGregor-Prairie du Chien vicinity.]

1928 The prairies again. Science 68:321-322. [Comment on papers by P. M. JONES and A. M. MILLER.]

1930 Land snails as indicators of ecological conditions. Ecology 11:673-686. [Incl. the forest-and-prairie map of Iowa, and map of principal loess deposits of the Mississippi valley.]

1931 The relation between the migrant and native flora of the prairie region. Univ. Iowa Studies in Nat. Hist. 14 (2):10-16. [Prairie plants, on anything like equal terms, hold their own against weeds. . . . On p. 15, importance and local dominance of dicot herbs, notably composites in Iowa (and Illinois) prairie. Grasses by no means sole dominants.]

1931 The botanical manuals and the Iowa flora. Univ. Iowa Studies Nat. Hist. 14 (2):17-37. [Iowa habitats for many plants not as given in manuals.]

1931 Ecological conditions during loess deposition. Univ. Iowa Studies in Nat. Hist. 14:38-54.

1933 Quercus macrocarpa, var. depressa (Nutt.) Engelm. Rhodora 35: 295-297.

SHIMEK, B., AND KING, CHARLOTTE M.

1933 Dr. Louis H. Pammel. [Obituary notice by SHIMEK, with bibl. of his writings by Miss KING]. Proc. Iowa Acad. Sci. 38:55-68. (1932). [Bibl. arr. by subjects, incl. pollination and morphol. of seeds and seedlings, ecology (25 titles); phenology (12); forestry and floras (50); parks and conservation (59). Many of these articles are very short. The majority deal with Iowa plants or areas.]

SHIPTON, W. D.

1918 Bibliography of the Driftless Area. Proc. Iowa Acad. Sci. 24:67-81. (1917).

SHORT, C. W.

1836 A sketch of the progress of botany in western America. Transylvania Jour. Med. and Associate Sciences 9 (no. 34) : 1-30. [Brief acct. of early botanical explorations, incl.: André Michaux and his son; John Bradbury (1810-1811), Pursh, Correade Serra, Nuttall, McMurtrie of Louisville (publ. a catalogue of Ky. plants), Rafinesque. Collecting trips by Short, Peter, and Griswold through particular districts of Ky. are described.]

1845 Observations on the botany of Illinois, more especially in reference to the autumnal flora of the prairies. Western Jour. of Med. and Surgery, New Ser. 3:185-198. [One of the best descriptions of virgin prairie of Illinois. Quoted extensively by Lapham. Recognized prairie groves or forest islands and their relation to fire, and protection from it by water courses. Also the barrens.—The gregarious habit of certain herbs in the prairie: "Its leading feature is rather the unbounded profusion with which a few species occur, in certain localities, than the mixed variety of different species occurring anywhere. Thus from some elevated position in a large prairie, the eye takes in thousands of acres literally empurpled with . . . Liatris; in other situations . . . yellow flowered Coreopsis occur in . . . profuse abundance. . . . This peculiarity of an aggregation of individuals of one or more species to something like an exclusive monopoly of certain localities, obtains even in regard to those plants which are the rarest and least frequently met with; for wherever one specimen was found, there generally occurred many more in the same immediate neighborhood."]

SHORT, C. W., PETER, ROBERT, AND GRISWOLD, HENRY A.

1833 Catalogue of the native phanerogamous plants and ferns of Kentucky. Transylvania Jour. Med. 6:3-14. [About 1,000 spp. listed. No notes on habitat, abundance, or locality.]

1835 A supplementary catalogue of the plants of Kentucky. Transylv. Jour. Med. 8 (no. 32) : 1-8. [225 spp. added. By SHORT and PETER.]

1837 A second supplementary catalogue . . . . etc. Ibid. 10: [no. and page citations not available.]

1837 A third suppl. . . . . etc. 10 (no. 3) : no pages cited. [This, and probably the preceding, by SHORT alone. Incl. about 40 ferns, 40 mosses, and 60 angiosperms.]

1840 A fourth suppl. . . . . etc. Vol. 10 [About 200 spp. By SHORT.]

SHULL, CHARLES A.

1921 Some changes in the vegetation of western Kentucky. Ecology 2:120-124. [The Barrens; disappearance of Arundinaria from the Cane Hills.]

SIMMONS, LILLIAN M.

1921 Forest distribution at the ends of the Lake Chicago beaches. Trans. Ill. State Acad. Sci. 13:226-239. (1920).

SIMPSON, CHARLES T.

1896 On the Mississippi Valley Unionidae found in the St. Lawrence and Atlantic drainage areas. Am. Nat. 30:379-384. [Infl. of Wabash-Maumee divide and former connection upon distr. of aquatic organisms.]

SMITH, B. H.

1932 The algae of Indiana. Proc. Ind. Acad. Sci. 41:177-306. (1931).

SMITH, BERTRAM G.

1908 The spawning habits of Chrosomus erythrogaster. Biol. Bull. 15: 9-18. [At Lake Forest, Ill.]

SMITH, ERNEST RICE

1933 The physiographic features of Pine Hills Nature Study Park, Montgomery county, Indiana. Proc. Ind. Acad. Sci. 42:153-161. [The well-known Devil's Backbone is one feature of this park. Topographic map faces p. 153. See FRIESNER and POTZGER 1934.]

SMITH, F. B., AND BROWN, P. E.

1932 Methods for determining carbon dioxide production in soils. Iowa Agr. Exp. Sta. Res. Bull., 1932:25-51. (Res. Bull. no. 147.)

SMITH, FRANK

1900 Notes on species of North American Oligochaeta. III. List of species found in Illinois, and descriptions of Illinois Tubificidae. Bull. Ill. State Lab. Nat. Hist. 5:441-458.

1911 Double-crested cormorants breeding in central Illinois. The Auk. 28:16-19.

1913 Earthworms from Illinois. Trans. Ill. (State) Acad. Sci. 5:145-148. (1912).

1915 The relation of our shrubs and trees to our wild birds. Ill. Arbor and Bird Day Circ. no. 83, pp. 8-17. Publ. by Supt. of Public Instruction, Springfield.

1928 An account of changes in the earthworm fauna of Illinois. Ill. State Nat. Hist. Surv. Bull. 17:347-362.

1930 Records of spring migration of birds at Urbana, Illinois, 1903-1922. Ill. State Nat. Hist. Surv. Bull. 19:105-117.

SMITH, GUY D.

1934 Experimental studies on the development of heavy claypans in soils. Univ. Mo. Agr. Exp. Sta., Res. Bull. 210. 32 pp. [Applies to Mo. and Ill. claypan areas.]

SMITH, ISABEL

1910 Native trees of Morgan county. Trans. Ill. State Acad. Sci. 2:15-18. (1909).

SMITH, ISABEL, BERGMAN, ROSS M., AND SMITH, GLENNA V.

1927 Survey of trees and shrubs of Morgan county. Trans. Ill. State Acad. Sci. 19:200-204. (1926).

SMITH, L. S.

1908 Climatic conditions [in Wisconsin]. Wis. Geol. and Nat. Hist. Surv. Bull. 20:14-21, et seq. (12 maps, rainfall 1895-1905.)

SMITH, M. R., AND BURRILL, A. C.

1919 A key to the species of Wisconsin ants, with notes on their habits. Ohio Jour. Sci. 19:279-292. See also the prelim. list, ibid. 18: 229-232. 1918.

SMITH, OWEN J.

1932 A study of the Tenebrionidae of southeastern Iowa. Proc. Iowa Acad. Sci. 38:259-265. (1931).

SMITH, RAYMOND STRATTON

1926 Quantitative methods in soil survey work. Jour. Am. Soc. Agron. 18:171-175.

1934 [Productive capacity of different Illinois soil types.] In: The land utilization problem in the central states from the standpoint of an agronomist. Central States Forestry Congr., Proc. 4th Ann. Conf. 1933:90-93. Springfield, Ill.

1934 Classification of Illinois lands. Trans. Ill. State Acad. Sci. 27:23-26. [Slopes steeper than 3 per cent are subject to erosion. Areas with very rapid natural underdrainage are subject to leaching and drought; those with very slow underdrainage, to formation of impervious claypans.]

SMITH, R. S., AND FISHER, F. A.

1922 The agricultural significance of the tight clay subsoil of southern Illinois. Trans. Ill. State Acad. Sci. 14:142-151. (1921).

SMITH, R. S., AND NORTON, E. A.

1929 The structural anatomy of the soil profile. Am. Soil Surv. Bull. 10:35-37.

1929 Provisional soil map of Illinois, together with brief description of the main soil groups. Univ. of Ill. Agr. Exp. Sta., Urbana. [Text mimeographed. A revision is in preparation.]

SMITH, VERA G. (See DAVIDSON, VERA SMITH)

1928 Animal communities of a deciduous forest succession. Ecology 9: 479-500. [6 different habitats selected to "represent stages in two or more similar seres." 2 on dry stripland ridges, Vermilion co., Ill., 1 on ridge subject to flooding, 1 in bottomland, 2 in poorly-drained upland forest, Champaign co.]

SNARE, WILBER, AND HICKS, E. W.

1898 List of native plants of Stark county, Illinois. Publ. by the Toulon Academy, Toulon, Ill. [Mr. V. H. Chase, Peoria, writes that much information is included, by use of symbols, but that there are many typographical errors.]

SNIDER, H. J.

1930 The cause and some effects of soil acidity. Trans. Ill. State Acad. Sci. 22:195-199. (1929). [General, with illustration from Ill. experiment fields.]

SNOW, LAETITIA M.

1902 The microcosm of the drift line. Am. Nat. 36:855-864. [Insect drift, L. Mich. beach, 72d St., Chicago, to S. Chicago.]

SNYDER, MARY J. See FRISON and SNYDER, and HART and SNYDER.

SOLHEIM, W. G., AND PENFOUND, W. T.

1928 A study of the algae of a freshwater stream. Trans. Ill. State Acad. Sci. 20:85-91. (1927). [Salt Fork, near Urbana.]

SOMES, M. P.

1912 Notes on some Iowa reptiles. Proc. Iowa Acad. Sci. 18:149-154. (1911).

1913 Notes on the flora of Johnson county, Iowa. Proc. Iowa Acad. Sci. 20:27-101. (1913).

SPARKS, JARED

1864 Life of Robert Cavelier de la Salle. Boston. C. C. Little and J. C. Brown. The library of Am. Biogr., 2d ser., vol. 1. 13 + 205 pp. (1st ed. in 1st series, vol. 1, 1848).

SPERRY, THEODORE M.

1933 Root-systems in Illinois prairie. Ph.D. thesis. Univ. Ill. 124 pp., pls.

1935 [Somewhat condensed form of above article.] Ecology 16: (In press).

SPIKER, CHAS. J.

1928 A second intensive ornithological survey of a typical square mile of cultivated prairie, after a ten-year interval. Proc. Iowa Acad. Sci. 34:323-326. (1927). 1st survey by ARTHUR A. ABEL (Proc. Iowa Acad. Sci. 27:385-393. 1920).

SPRINGER, LURA

1931 An ecological survey of the forests of the Sangamon River valley of Champaign county. Trans. Ill. State Acad. Sci. 23:188-199. (1930).

STANDLEY, PAUL C.

1912 A new leather-flower from Illinois. Smithson. Misc. Collections, vol. 56, no. 34. (Publ. 2070). 3 pp., 1 pl. [Viorna Ridgwayi, coll. by R. Ridgway near Olney. Incl. descr. of Bird Haven and its woody plants.]

1929 Two new plants from Illinois. Rhodora 31:36-38.

STANLEY, ALFRED R.

1931 Notes on some Iowa Cladonias. Proc. Iowa Acad. Sci. 37:95-96. (1930).

STEAGALL, MARY M.

1927 Some Illinois Ozark ferns in relation to soil acidity. Trans. Ill. State Acad. Sci. 19:113-136. (1926).

STEIN, HILDA A.

1934 Ambystoma talpoideum (Gray) in Illinois. Abstract. Trans. Ill. State Acad. Sci. 26:135. (1933 meeting).

STEJNEGER, L.

1899 The birds of Indiana. Am. Nat. 33:65-69.

STEVENS, FRANK E.

1924 James Watson Webb's trip across Illinois in 1822. Sycamore, Ill. 16 pp.

STEVENSON, W. H., AND BARKER, J. F.

1911 The gumbo soils of Iowa. Iowa Agr. Exp. Sta. Bull., 1910-11:283-305. (Bull. no. 119.) [Black clay, s.e. corner of Iowa, and near Missouri River.]

STEVENSON, W. H., AND BROWN, P. E.

1921 Iowa experience on the classification and nomenclature of soils. Am. Soil Surv. Assoc. Bull. 1:4-11.

1923 The Iowa system of soil management. Iowa Agr. Exp. Sta. Bull., 1923-24:289-318. (Bull. no. 213.)

STEVENSON, W. H., CHRISTIE, G. I., AND WILLCOX, O. W.

1905 The principal soil areas of Iowa. Iowa Agr. Exp. Sta. Bull., 7:371-394. (Bull. no. 82.) [Large colored map, showing distr. of 6 principal types.]

STEWART, J. T.

1883 Shade trees, indigenous shrubs and vines. 2d ed., revised and improved. 37 pp., 1 drawing. Transcript Publ. Co., Peoria, Ill.

1887 Aims and objects of the Peoria Scientific Association. Bull. Sci. Assoc. Peoria. 1887:3-11. Publ. by the Assoc. Edward Hine and Co., Printers, Peoria.

1887 Flora of Peoria. Bull. Sci. Assoc. Peoria 1887:28-33.

STEWART, ROBERT

1910 Quantitative relationships of carbon, phosphorus, and nitrogen in soils. Bull. Univ. Ill. Agr. Exp. Sta. 10:89-128 (no. 145). [Includes intensive chemical study of brown silt loam, Champaign co., Ill.] 2d ed. 1912.

STEYERMARK, J. A.

1931 A study of plant distribution in relation to the acidity of various soils in Missouri. Ann. Mo. Bot. Gard. 18:41-55.

1933 Notes on Missouri plants. Rhodora 35:282-291.

1934 Some features of the flora of the Ozark region in Missouri. Rhodora 36:214-233. [3 floristic elements: Ozarkian, S. Appalachian, and a combination of the two.]

STIMPSON, WILLIAM

1870 On the deep-water fauna of Lake Michigan. Am. Nat. 4:403-405. [Dredgings off Chicago and in deeper waters east of Racine.]

STOMPS, T. J.

1915 The dunes of Lake Michigan. Plant World 18:205-216.

STOVER, E. L.

1930 A mesophytic ravine, Rocky Branch. Teachers Coll. Bull. of the Eastern Ill. State Teachers Coll., Charleston, no. 110, pp. 1-26.

STRODE, W. S.

1892 The Unionidae of Spoon River, Fulton county, Illinois. Am. Nat. 26:495-501.

1892 A morning on Spoon River, Ill. Ornithologist and Oologist 17:34-36. —Bald eagle in Fulton co. 17:165.

STRODE, W. S.—*Continued*

1893 An old-time outing. Ornithologist and Oologist 18:86-90. ["California Bend" at junction of Spoon River with the Illinois. Bottomland forest, incl. much pecan. Wild turkey abund. between 1863 and 1865.]

1920 The prothonotary warbler. Trans. Ill. State Acad. Sci. 11:185-186. (1918). [Habitat along Ill. river.]

SURBER, THADDEUS

1913 Notes on the natural hosts of fresh-water mussels. Bull. U. S. Bur. Fish. 32:101-116.

1915 Identification of the glochidia of fresh-water mussels. Rept. U. S. Commr. Fisheries for 1914, Appendix 5. (Doc. no. 813.) 9 pp.

SVENSON, HENRY K.

1927 Studies on interior distribution of maritime plants; I. Effect of post-Pleistocene marine submergence in eastern North America. Rhodora 29:41-48, 57-72, 87-93, 105-114. [Occurrence of these plants along shores of Great Lakes (and in many other stations).]

TALBOT, MARY

1934 Distribution of ant species in the Chicago region with reference to ecological factors and physiological toleration. Ecology 15:416-439.

TANQUARY, M. C.

1912 A preliminary list of ants from Illinois. Trans. Ill. State Acad. Sci. 4:137-142. (1911).

TAYLOR, ARAVILLA M.

1919 Mosses as formers of tufa and floating islands. Bryologist 22:38-39. [Mosses of iron springs, Otis, Ind. and New Lenox, Ill.; others in quaking bog at Mineral Springs, Ind.]

1920 Ecological succession of mosses. Bot. Gaz. 69:449-491. [Dunes, Chicago area, and near Mt. Carroll, n. w. Ill.]

1921 Appearance of mosses in ecological habitats. Bryologist 23:81-84. (1920). [Chicago area and L. Mich. dunes.]

TAYLOR, ARTHUR E.

1907 The peat deposits of northern Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 31:73-298. (1906).

TAYLOR, FRANK BURSLEY

1908 A short history of the Great Lakes. Dryer's Studies in Indiana Geography, pp. 90-111. See DRYER, 1908.

TAYLOR, MRS. H. J.

1928 The history and distribution of yellow Nelumbo, water chinquapin, or American lotus, Nelumbo lutea (Willd.) Pers. Proc. Iowa Acad. Sci. 34:119-124. (1927).

TEHON, L. R.

1922 The Illinois plant disease survey. Trans. Ill. State Acad. Sci. 15: 141-150.

1923 The habitat of the naturalized common barberry in Illinois. Trans. Ill. State Acad. Sci. 15:151-164. (1922).

TEHON, L. R.—*Continued*

1924 A preliminary report on the occurrence and distribution of the common bacterial and fungous diseases of crop plants in Illinois. Bull. Ill. State Lab. Nat. Hist. 15:173-325. 127 maps.

1924 to 1933 Notes on the parasitic fungi of Illinois. Mycologia, vols. 16, 17, 19, 21, 25. I. 16:135-142. 1924——II. (with E. Y. DANIELS) 17:240-249. 1925——III. (L.R.T.) 19:110-129. 1927——IV. (with G. L. STOUT) 21:180-196. 1929——V. (L.R.T.) 25:237-257. 1933.

1927 Epidemic diseases of grain crops in Illinois, 1922-1926. . . . [with] interpretation of weather relations . . . Bull. Ill. State Nat. Hist. Surv. 17:1-96.——See TEHON and YOUNG.

1928 Methods and principles for interpreting the phenology of crop pests. Bull. Ill. State Lab. Nat. Hist. 17:321-346.

1929 Distribution of Potamogeton crispus L. in North America. Torreya 29:42-46.

1934 Elm diseases in Illinois. Proc. 10th Nat. Shade Tree Conf., Pittsburgh. 1934:105-111.

TEHON, L. R., AND YOUNG, P. A.

1924 Notes on the climatic conditions influencing the 1932 epidemic of stem rust on wheat in Illinois. Phytopath. 14:94-100. [See TEHON 1927.]

SEE MILLER AND TEHON 1929

TELFORD, C. J.

1924 Growth studies of certain bottomland [tree] species in southern Illinois. Trans. Ill. State Acad. Sci. 16:210-213. (1923).

1926 Third report on a forest survey of Illinois. (A woodland inventory, including growth and yield studies.) Ill. State Nat. Hist. Surv. Bull. 16:1-102.

1926 Brownfield woods: a remnant of the original Illinois forest. Circ. no. 3, Forestry Series, Ill. State Nat. Hist. Surv. 16 pp. [4 miles n. e. of Urbana. This and the University Woods may owe their peculiarities to their history. They developed by occupation of prairie upland, perhaps 400 years ago.—A. G. V.]

TEST, LOUIS A. AND FREDERICK H.

1931 to 1933 Birds of Tippecanoe county. Proc. Ind. Acad. Sci. [I] 40:371-373. (1930).—II. 41:465-481 (1931) 1932.—III. 42:269-285 (1932) 1933.

TEST, FREDERICK H.

1930 Pteridophytes of Turkey Run State Park. Proc. Ind. Acad. Sci. 39:115-118. (1929). See BEHRENS, 1928.

THOMAS, CYRUS

1859 Orthoptera of Illinois. Trans. Ill. State Agr. Soc. 3:682-685 (1857-8). Read before Ill. State Nat. Hist. Soc., 1859.

1861 Notes on Illinois insects [with catalogue of Coleoptera]. Trans. Ill. State Agr. Soc. 4:631-649. (1859-60). [List a combination of records of HELMUTH, WALSH, E. BRENDEL, the EVANSTON INSTITUTION, and THOMAS. Names only.]

THOMAS, CYRUS—*Continued*

1861 Mammals of Illinois. Catalogue. Trans. Ill. State Agr. Soc. 4:651-661. (1859-60). [Includes notes on distribution and abundance.]

1861 Plan for a natural history survey. Trans. Ill. State Agr. Soc. 4:663-665. (1859-60).

1876 A list of the Orthoptera of Illinois. Bull. Ill. State Mus. [Lab.] Nat. Hist. 1:59-69.

1878 The Coleoptera, or beetles [of Illinois]. In 6th rept. Ill. State Entomologist, pp. 63-174.

1880 Acrididae of Illinois. In 9th rept. Ill. State Entomologist. pp. 71-140.

1880 Temperature and rainfall as affecting the chinch bug. Periodicity in its increase. Am. Ent. 3 (new ser. 1:) 240-242.

1880 [Brief notes on grasshoppers in so. Ill.] Am. Ent. 3: (new ser. 1:) 250, 251. [Local abund. of Acridium americanum (result of drought and heat), and tendency of Camnula pellucida to become long-winged and migratory. A pre-glimpse of an important modern discovery.]

1881 Relation of meteorological conditions to insect development. In 10th rept. Ill. State Entomologist, pp. 47-59.

THOMPSON, DAVID H.

1925 Some observations on the oxygen requirements of fishes in the Illinois River. Ill. State Nat. Hist. Surv. Bull. 15:423-437.

1927 An epidemic of leeches on fishes in Rock River. Ill. State Nat. Hist. Surv. Bull. 17:195-201.

1931 Variation in fishes as a function of distance. Trans. Ill. State Acad. Sci. 23:276-281. (1930).

1932 The fishing industry of Illinois River. Trans. Ill. State Acad. Sci. 24:592-595. (1931).

THOMPSON, D. H. AND HUNT, F. D.

1930 The fishes of Champaign county: a study of the distribution and abundance of fishes in small streams. Ill. Nat. Hist. Surv. Bull. 19:1-101. 52 maps.

THOMPSON, MAURICE

1887 Geographic botany. Ind. Dept. Geol. and Nat. Hist., Ann. Rept. 15:242-252 (1886).

1889 Preliminary sketch of the characteristic plants of the Kankakee region. Ind. Dept. Geol. and Nat. Hist., Ann. Rept. 16:155-161. (1888). [Incl. Coulter's lake, prairie and barrens regions of n. w. Ind. Mentions plants char. of prairie, dunes, boggy flats, and other habitats.]

1889 Preliminary sketch of the aquatic and shore birds of the Kankakee region. Ind. Dept. Geol. and Nat. Hist., Ann. Rept. 16:162-164. (1888).

THONE, FRANK

1922 Ecological factors in the region of Starved Rock, Illinois. Bot. Gaz. 74:345-368.

THONE, FRANK—*Continued*

1923 Evaporation rates on rock canyon walls. Bot. Gaz. 76:419-424.

1923 Advantages of river canyons for ecological study. Trans. Ill. State Acad. Sci. 15:202-207. (1922).

1925 Preliminary check list of the vascular plants of Illinois State Park at Starved Rock, LaSalle county. Trans. Ill. State Acad. Sci. 17:100-106. (1924).

THWAITES, REUBEN GOLD

1904 to 1907 Early Western travels. (A series of annotated reprints). Edited with notes, introductions, index, etc. 32 vols. (1748 to 1846). Cleveland. Arthur H. Clark Co.

TODD, JAMES E.

1896 Formation of the Quaternary deposits [of Mo.]. Repts. Mo. Geol. Surv. 10:111-217.

TRACY, S. M.

1886 Catalogue of the phaenogamous and vascular cryptogamous plants of Missouri. Jefferson City, Tribune Printing Co. 106 pp. [Some brief habitat and abundance notes.]

TRANSEAU, E. N.

1913 The periodicity of algae in Illinois. Trans. Am. Micr. Soc. 32:31-40.

1914 Annotated list of the algae of eastern Illinois. Trans. Ill. [State] Acad. Sci. 6:69-89. (1913).

1916 The periodicity of freshwater algae. Am. Jour. Bot. 3:121-133.

TRELEASE, WILLIAM

1918 The chestnut in Illinois. Trans. Ill. [State] Acad. Sci. 10:143-145. (1917).

1920 The jack oak [or Hill's oak] (Quercus ellipsoidalis). Trans. Ill. State Acad. Sci. 12:108-118. (1919). [See also HILL 1906.]

TRELEASE, WM. AND GRAY, ASA (Editors)

1887 The botanical works of the late George Engelmann, collected for Henry Shaw, esq. Cambridge, Mass., J. Wilson and Son. 548 pp., 103 pls. [Hill's oak, p. 408; germination of acorns, 408-409; Geyer's plants, 506-510; Silphium laciniatum, 530, 533.]

TRENK, FRED B.

1926 The occurrence of hickories in Iowa in relation to soil types. Proc. Iowa Acad. Sci. 32:143-155. (1925). [Includes classifications of Iowa soils by Iowa Agr. Exp. Sta., pp. 147-148.]

1928 [Same title.] Proc. and Papers 1st Internat. Congr. Soil Sci., Washington (1927). 4:318-322.

TROWBRIDGE, A. C.

1912 Geology and geography of the Wheaton quadrangle. Ill. Geol. Surv. Bull. No. 19. 79 pp.

1913 Some partly dissected plains in JoDaviess county, Illinois. Jour. Geol. 21:731-742.

1921 Erosional history of the Driftless Area. Univ. Iowa Studies Nat. Hist. 9 (3):5-127.

TROWBRIDGE, A. C., AND SHAW, E. W., AND SCHOCKEL, B. H.

1916 Geology and geography of the Galena and Elizabeth quadrangles. Ill. State Geol. Surv. Bull. no. 26. 233 pp.

TURNER, HELEN

1923 Ecology of Rhus toxicodendron. Trans. Ill. State Acad. Sci. 15:208-211. (1922).

TURNER, LEWIS M.

1928 A preliminary report on an ecological problem in the Illinois River valley. Trans. Ill. State Acad. Sci. 20:137-139. (1927). [Infl. of levees, flooding, pollution.]

1930 The 1926-27 floods and the Illinois River valley vegetation. Trans. Ill. State Acad. Sci. 22:95-97 (1929). [Prolonged flooding and burial by sediment kill 90% of pin oaks, elms, cottonwoods, near LaGrange locks.]

1932 Plant succession on levees in the Illinois River valley. Trans. Ill. State Acad. Sci. 24:94-102. (1931).

1934 Grassland in the floodplain of Illinois Rivers. Am. Midland Nat. 15:770-780. [Near mouth of Apple Creek in Greene co., and near Hillview, Pike co.]

1934 Grassland in the floodplain of Illinois Rivers. Trans. Ill. State Acad. Sci. 26:71-72. (1933).

UDDEN, JOHAN A.

1898 The mechanical composition of wind deposits. Augustana Library Publications, No. 1. 69 pp. Augustana College, Rock Island, Ill. [Data for dune sands of L. Mich., and inland sands and dusts of Ill. and other prairie states. Bearing on loess problems discussed.]

1912 Geology and mineral resources of the Peoria quadrangle, Illinois. U. S. Geol. Surv. Bull. no. 506. 103 pp.

ULFFERS, H. A.

1855 Mollusca of southern Illinois. Trans. Ill. State Agr. Soc. 1:610-612 (1853-4). [Names only.]

ULLRICH, FRED THEODORE

1915 The relation of evaporation and soil moisture to plant succession in a ravine. Bull. Ill. State Lab. Nat. Hist. 12:1-16. [Ravine near Lake Michigan, north of Chicago.]

UPHOF, J. C.

1922 Ecological relations of plants in southeastern Missouri. Am. Jour. Bot. 9:1-18.

U. S. GEOLOGICAL SURVEY

Geologic atlas of the U. S.: folios of Illinois areas, no.:

1900 67 Danville.

1902 81 Chicago, Riverside, DesPlaines, and Calumet.

1904 105 Patoka.

U. S. GEOLOGICAL SURVEY (AND ILLINOIS GEOLOGICAL SURVEY)

Topographic maps of Illinois quadrangles. 289 quadrangles in the state. The 130 + available to Sept. 1, 1933, including advance photolithographic maps, are listed on p. 39 of the 1933 list of publications of the Illinois Survey. Their locations shown on the index map, p. 38.

Geologic atlas of the U. S.: folios of Illinois areas, no.:

1907 145 Lancaster-Mineral Point.
1913 185 Murphysboro and Herrin (1912).
1913 188 Tallula and Springfield.
1915 195 Belleville and Breese.
1916 200 Galena and Elizabeth.
1919 208 Colchester and Macomb.
1921 213 New Athens and Okawville.
1923 216 Carlyle and Centralia.
1926 220 Gillespie-Mount Olive.

VAN CLEAVE, H. J.

1928 The fairy shrimps of Illinois. Trans. Ill. State Acad. Sci. 20:130-132. (1927).

1928 A study of the characters for the identification of the snakes of Illinois. Trans. Ill. State Acad. Sci. 20:133-136. (1927). [41 spp. enumerated.]

VAN CLEAVE, H. J., AND MARKUS, H. C.

1929 Studies on the life history of the blunt-nosed minnow. Am. Nat. 53:530-539. Abstr. in Trans. Ill. State Acad. Sci. 22:185. (1929).

VAN HOOK, MARY L.

1905 Illinois ferns near Lake Michigan. Fern. Bull. 13:23-25.

VAN ZANDT, NICHOLAS BIDDLE

1818 A full description of the soil, water, timber, and prairies of each lot, or quarter section of the military lands between the Mississippi and Illinois Rivers. Washington City, P. Force. 127 pp. [Sample township description, p. 57: Range 6 W, Town 6 N: "Timber—oak, lynn, and hackberry—hazle. Prairie generally rolling." R 7 W, T 3 N: "Timber—oak. Half the town is prairie, residue principally brushy barrens."—Pp. 85-97, description of the Illinois Territory; pp. 98-115, Missouri Territory.]

VASEY, GEORGE

1859 Mosses of Illinois. Trans. Ill. State Agr. Soc. 3:676-679. (1857-8).

1861 Additions to the flora of Illinois. Trans. Ill. State Agr. Soc. 4:667-671. (1859-60). Also as: Additions to the Illinois Flora. Prairie Farmer 22: (new ser. 6;) 119. [Includes list of 58 spp. contr. by S. B. MEAD, of Augusta, Ill. Nearly half of these are introduced spp. Vasey adds 113 native plants.]

1870 [Southern Illinois plants.] Am. Ent. and Bot. 2:191. See also 2:288, and 2:384.

1870 The oaks. I. (White, bur, and post oaks). Am. Ent. and Bot. 2:249-250. [Bur oak the common tree of oak openings; post oak flats of so. Ill.]

VASEY, GEORGE—*Continued*

1870 Origin of prairie vegetation. Am. Ent. and Bot. 2:277-280. [Criticisms of WINCHELL'S rather extravagant ideas, with suggestions on upstream migration of trees into prairie.]

1870 New plants [Saxifraga Forbesii (n. sp.) and Heuchera sp., shaded cliffs, Cobden and Makanda.] Am. Ent. and Bot. 2:288. See p. 310, note by FORBES on the Heuchera.

1870 Maritime plants of the Great Lakes and the interior. Am. Ent. and Bot. 2:342-344. [Incl. remarks by WARNE. Mentions prickly pear in sandy fields n. of Chicago.]

VERINK, E. D.

1915 Preliminary report on the flora of Linn county, Iowa. Proc. Iowa Acad. Sci. 21:77-99. (1914). [Degree of abundance given for certain spp.]

VESTAL, ARTHUR G.

1913 An associational study of Illinois sand prairie. Bull. Ill. State Lab. Nat. Hist. 10:1-96. [Animals and plants, principally in Ill. River dunes near Havana. See HART and GLEASON, 1907.]

1914 A black-soil prairie station in northeastern Illinois. Bull. Torr. Bot. Club 41:351-363.

1914 Internal relations of terrestrial associations. Am. Nat. 48:413-445. [Based principally on studies of sand-prairie animals and plants of Ill.]

1920 Local inclusions of prairie within forest. Trans. Ill. State Acad. Sci. 11:122-126. (1918). [E. centr. Ill.]

1920 Invasion of forest land by prairie along railroads. Trans. Ill. State Acad. Sci. 11:126-128. (1918). [E. centr. Ill.]

1920 Preliminary account of the forests in Cumberland County, Illinois. Trans. Ill. State Acad. Sci. 12:234-245. (1919).

1931 A preliminary vegetation map of Illinois. Trans. Ill. State Acad. Sci. 23:204-217 (1930). 3 maps.

1931 Review of Weaver and Clements, "Plant Ecology" (McGraw-Hill, N. Y. 520 pp. 1929).—Ecology 12:232-239. [Possibility of Illinois prairie climax, and that prairie and forest each helps to determine its own climate.]

1932 Strategic habitats and communities in Illinois. Trans. Ill. State Acad. Sci. 24:80-85. (1931).

1934 Segregation of vegetation into associations and into less extensive units. (Abstract). Bull. Ecol. Soc. Am. 15:31. "Many regularly gregarious herbs are typical of Illinois prairie, making the prairie a patchwork superposed on a blended ground-fabric of many other species." Cf. SHORT, 1845.

VISHER, S. S.

1929 The climate of Kentucky. Ky. Geol. Surv., Ser. 6, 31:81-167.

VON SCHRENK, HERMANN

1898 The trees of St. Louis as influenced by the tornado of 1896. Trans. Acad. Sci. St. Louis 8:25-41. 6 pls. [Injuries, and growth reactions following storm. See NORTON, J. B. S., 1897.]

VON SCHRENK, HERMANN—*Continued*

1900 A severe sleet-storm. Trans. Acad. Sci. St. Louis 9:143-150. 4 figs. [Glaze storm, Feb. 27, 1900; Mo., Ill., Ind., Ohio. Effects on trees; their ability to withstand ice loads. Refs. to earlier descriptions.]

VOSS, JOHN

1932 Preliminary report on the paleo-ecology of a Wisconsin and an Illinois bog. Trans. Ill. State Acad. Sci. 24:130-137. (1931).

1933 Pleistocene forests of central Illinois. Bot. Gaz. 94:808-814. Abstract in Trans. Ill. State Acad. Sci. 25:130. 1933.

1934 Postglacial migration of forests in Illinois, Wisconsin, and Minnesota. Bot. Gaz. 96:3-43. [Pollen diagrams from bogs in n. Ill., Wis., and e. Minn., with conclusions as to succession of forests in the different localities. Postglacial climatic change gradual, with no indication of considerable fluctuation as suggested in other regions.]

WADMOND, S. C.

1910 Flora of Racine and Kenosha counties, Wisconsin. Trans. Wis. Acad. Sci., Arts, and Letters, 16 (part 2):798-888.

1933 The Quercus ellipsoidalis—Quercus coccinea complex. Trans. Wis. Acad. Sci., Arts, and Letters 28:197-203. Map.

WALKER, R. H., FIRKINS, B. J., AND BROWN, P. E.

1931 The measurement of the degree of saturation of soils with bases. Iowa Agr. Exp. Sta. Res. Bull., 1931:153-176. (Res. Bull. no. 139). [Data for prevailing soil types of Iowa.]

WALTER, HERBERT EUGENE, AND ALICE HALL WALTER

1904 Wild birds in city parks; being hints on identifying 145 birds, prepared primarily for the spring migration in Lincoln Park, Chicago. Rev. and enlarged ed. Chicago, A. W. Mumford. 66 pp., folding chart. (1st ed. 1903; 1905 ed. also.)

WANLESS, HAROLD R.

1928 Pleistocene and recent history of Alexis quadrangle and vicinity [Mercer and Warren counties]. Trans. Ill. State Acad. Sci. 20: 254-260. (1927).

1929 Nebraskan till in Fulton county, Illinois. Ill. State Acad. Sci. 21: 273-282. (1928).

1929 Geology and mineral resources of the Alexis quadrangle. [n. Warren co.] Ill. State Geol. Surv. Bull. No. 57. 230 pp.

WARD, LESTER F.

1878 St. Louis and botany. Field and Forest 3:170-172. [Iron Mountain district of e. Mo.; Cahokia Mound, Ill.]

WARNE, H. A.

1870 A list of plants growing in the vicinity of Chicago during March, April, and May. Am. Ent. and Bot. 2:313-314. [Prairie at Graceland and Hyde Park; forests of north branch, Chicago River, and of DesPlaines River; dunes and lake-shore veg.] Continued as Notes on plants collected near Chicago, pp. 345-348. [Calumet district, dunes and strand s. of Chicago and into Indiana, incl. bog habitats.]

[WARNER & BEERS]

1876 Atlas of Illinois, to which are added history, statistics, geology, topography, flora, fauna, etc. Chicago, Warner & Beers, publishers. 293 pp., 116 maps, 32 pls. Folio.

WASCHER, HERMAN

1934 Plant composition of Illinois peat bogs. M. A. thesis, Univ. of Ill. 24 pp.

WATERMAN, W. G.

1920 Preliminary report on the north two tiers of sections in Niles township, Cook County, Illinois. Trans. Ill. State Acad. Sci. 12:205-207. (1919). [Forest survey].

1921 Distribution of oaks on the Lake Chicago bars in Evanston and New Trier townships. Trans. Ill. State Acad. Sci. 13:239-242. (1920).

1922 Preliminary report on the bogs of northern Illinois. Trans. Ill. State Acad. Sci. 14:79-84. (1921).

1923 Bogs of northern Illinois—II. Trans. Ill. State Acad. Sci. 16:214-225.

1926 Ecological problems from the sphagnum bogs of Illinois. Ecology 7:225-272.

WEBER, JESSIE PALMER, AND OSBORNE, GEORGIA L.

1905 An outline for the study of Illinois State history. Ill. State Historical Library. Springfield. H. W. Rokker Co., Printers. 94 pp.

WEBSTER, F. M.

1880 Notes upon the food of predaceous beetles. Bull. Ill. State Lab. Nat. Hist. 1(3):162-166. 2d ed. 1903.

WEED, C. M.

1889 On an outbreak of injurious locusts in central Illinois. In 15th rept. Ill. State Entomologist, pp. 40-44.

1890 A descriptive catalogue of the Phalangiinae of Illinois. Bull. Ill. State Lab. Nat. Hist. 3:79-97.

WEESE, ASA ORRIN

1925 Animal ecology of an Illinois elm-maple forest. Ill. Biol. Monographs 9 (4):345-438. 7 pls. Bibl. pp. 411-415. [University woods, 5 mi. e. n. e. of Urbana.] (Paging of separate is 1-93).

WELCH, WINONA H.

1926 An ecological study of the flora of Fountain, Parke, and portions of adjacent territory, Jasper county, Indiana. Proc. Ind. Acad. Sci. 35:201-212. (1925).

1927 Enumeration of the vascular flora of Jasper county, Indiana. Proc. Ind. Acad. Sci. 36:213-220 (1926).

1931 Additions . . . 40:119-121. (1930).

1929 Phytoecology of southern Indiana, with special reference to certain Ericaceae in the limestone area of the Bloomington quadrangle. Proc. Ind. Acad. Sci. 38:65-83. (1928).

1930 Forest and prairie, Benton county, Indiana. Proc. Ind. Acad. Sci. 39:67-72. (1929). [Isolated prairie groves, as in Ill., in an Ind. extension of the Grand Prairie. See GORBY, 1886; GLEASON, 1912, 1913; and VESTAL, 1932.]

1932 An ecological study of the bald cypress in Indiana. Proc. Ind. Acad. Sci. 41:207-213. (1931).

WELD, LEWIS H.

1928 Cynipid galls of the Chicago area. Trans. Ill. State Acad. Sci. 20: 142-177. (1927). [146 gall varieties, arranged by hosts and otherwise.]

WELLER, J. MARVIN

1934 Tri-state geological field conference of the upper Mississippi valley. Science, n. s., 79:80-82.

WELLER, STUART, AND OTHERS

1920 [Brief form of] Geology of Hardin county and the adjoining part of Pope county. Ill. State Geol. Surv. Bull. no. 41A. 146 pp. (41: 1-75, 235-310).

WELLER, STUART, AND ST. CLAIR, STUART

1928 Geology of Ste. Genevieve county, Missouri [and parts of Perry and St. Francois counties]. [Repts.] Mo. Bur. Geol. and Mines, 2d ser., vol. 22. 352 + 10 pp. (index), large topogr. and geol. maps. [History, pp. 12-19; topogr., etc., 20-29. Pleistocene deposits, by E. W. SHAW, with note by F. LEVERETT, pp. 251-255.]

WELLS, MORRIS M.

1916 Resistance and reactions of fishes to temperature. Trans. Ill. [State] Acad. Sci. 7:49-59. (1914).

WELLS, R. W.

1819 On the origin of prairies. Am. Jour. Sci. and Arts. (ser. 1) 1:331-337. [Believes prairies and barrens of Alleghany mts. and of Ohio, Ind., and Ill. were largely originated and continued by fire, that Indians set fires in forests, that continued fires destroyed forests, that new forests develop after cessation of fires, or where "prairie has been depastured by large herds of domestic cattle." Examples of newly forested areas near St. Louis and St. Charles, Mo.]

WENTWORTH, C. K.

1926 Methods of mechanical analysis of sediments. Univ. Iowa Studies Nat. Hist. 11 (11):1-52. See also v. 14, no. 3. 1931.

1931 The mechanical composition of sediments in graphic form. Univ. Iowa Studies Nat. Hist. 14 (3):1-127. [Includes Ill. lag gravel, dune and other sands, dusts (some from accumulations on trees), and till (boulder clay).]

WEST, JAMES A.

1910 A study of the food of moles in Illinois. Bull. Ill. State Lab. Nat. Hist. 9:14-22.

WHITBECK, R. H.

1911 Contrasts between the glaciated and driftless portions of Wisconsin. Bull. Geogr. Soc. Philad. 9:114-123.

1913 Economic aspects of glaciation in Wisconsin. Ann: Assoc. of Am. Geographers 3:62-87.

1920 Geography of southeastern Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. no. 58. 160 pp.

1921 The geography and economic development of southeastern Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. 58. 2d ed. 252 pp.

WHITE, HELEN L.

1931 The phytoplankton of a solution pond with special reference to the periodicity of certain algae. Proc. Ind. Acad. Sci. 40:123-140. (1930). [Pond near Bloomington, Ind. Extensive bibl. on ecol. of algae.]

WHITNEY, J. D.

1858 Physical geography [of Iowa]. Chapter 1 in: Report on the Geol. Surv. of the State of Iowa. Vol. 1, part 1: Geology. [Prairies in wide bottoms of Miss. R., p. 15-16; upland prairies and groves, pp. 20-27.]

1876 Plain, prairie, and forest. Am. Nat. 10:577-588; 656-667. [Distr. of forest and prairie independent of climate, therefore attributable to differences in soil and topography.—Includes discussion of particular areas in Ill., Iowa, Mo., Wis.]

WHITSON, A. R.

1927 Soils of Wisconsin. Wis. Geol. and Nat. Hist. Surv. Bull. no. 68 (Soil Ser. no. 49). 270 pp. Large colored map. List of reports on Wis. soils, pp. 259-261.

WHITSON, A. R., AND BAKER, O. E.

1928 The climate of Wisconsin and its relation to agriculture. Univ. Wis. Agr. Exp. Sta., Bull. No. 223, 2d ed. revised. 65 pp. (1st ed., 1912).

[Local climatic summaries are included in county soil reports.]

WHITSON, A. R., AND OTHERS

[Soil maps for southern tier of Wisconsin counties (not yet publ. for Grant and LaFayette counties).] Wis. Geol. and Nat. Hist. Surv. Bull. no.:

1922 53B (Soil Ser. no. 21) Rock co.

1923 56B (Soil Ser. no. 29) Racine-Kenosha area.

1924 56C (Soil Ser. no. 30) Walworth co.

1930 53C (Soil Ser. no. 22) Green co.

[For other Wis. soil maps see 18th Bienn. Rept., Wis. Geol. and Nat. Hist. Surv., 1932:20-38. Index map, p. 23.—Soil Survey transferred to Univ. of Wis., 1931.]

WICKHAM, H. F.

1899 The habits of American Cicindelidae. Proc. Davenport Acad. Nat. Sci. 7:206-228.

1909 A list of the Coleoptera of Iowa. Bull. Lab. Nat. Hist. State Univ. Iowa 6:1-40.

WIEBE, A. H.

1927 Biological survey of the upper Mississippi river with special reference to pollution. U. S. Bur. Fish. Bull. 43:137-167.

WILDE, S. A.

1933 The relation of soils and forest vegetation in the Lake States region. Ecology 14:94-105. [Correlation of forest types with soil texture, topography, water level.]

WILLARD, D. E.

1893 Some geological features of Jackson Park, Chicago. Science, Old Series 22:309-310.

WILLEY, FLORENCE

1920 The vegetative organs of some perennial grasses. Iowa Acad. Sci. 25:341-367. (1919). [Incl. native prairie dominants.]

WILLEY, HENRY

1877 List of Illinois lichens. Bot. Gaz. 2:77-78. [113 spp. and varieties, coll. by J. WOLF, of Canton, Ill. Some of them are "rail lichens."] See WOLF and HALL, 1878.

1878 Lichens of southern Illinois. Bot. Gaz. 3:21-22. [61 spp. and varieties, coll. by J. WOLF.]

WILLIAMS, F. E.

1914 The climate of Wisconsin. Jour. Geogr. 12:232-234.

WILLIAMSON, E. B.

1900 The dragonflies of Indiana. Ind. Dept. Geol. and Nat. Resources, Ann. Rept. 24:229-333. (1899).

WILSON, ALBERT C.

1931 Rules and regulations: Illinois seed and weed control laws. State Dept. Agr., Div. of Seed Inspection. Springfield Seed Laboratory, Bull. no. 330. 54 pp.

WILSON, BEN H.

1924 An excellent example of high clay bank erosion in Lee county, Iowa. Proc. Iowa Acad. Sci. 30:425-431. (1923).

WILSON, CHARLES BRANCH

1920 Dragonflies and damselflies in relation to pondfish culture, with a list of those found near Fairport, Iowa. U. S. Bur. Fish., Doc. 882. 86 pp. (Bull. U. S. Bur. Fish. 36:179-264. Bibl., pp. 260-264).

WILSON, CHARLES B., AND CLARK, H. WALTON

1912 The mussel fauna of the Maumee River. U. S. Bur. Fish., Doc. 757. 72 pp. [Geol. and geogr. of the Maumee and upper Wabash Basins, pp. 3-8. Biol. of the Maumee River, pp. 8-10.] See SIMPSON, 1896.

1912 The mussel fauna of the Kankakee Basin. U. S. Bur. Fish. Doc. no. 758. 52 pp. Map. [Physical features of the Kankakee Basin, pp. 4-7.]

WILSON, J. D.

1932 Environmental factors in relation to plant disease and injury: a bibliography. Ohio Agric. Exp. Sta., Tech. Ser., Bull. 9. 203 pp.

WINCHELL, ALEXANDER

1864 On the origin of the prairies of the valley of the Mississippi. Am. Jour. Sci. and Arts, 2d ser., 38:332-344. (An earlier version "in the Ladies' Repository for May, 1863.") [Believes in lake-deposit origin of prairies.]

1876 Treelessness of prairies. In Cochrane's Centennial History of Mason County.
See COCHRANE, J., 1876.

WINKENWERDER, H. A.

1902 Notes on the winter habits of the red-headed woodpecker. Bull. Wis. Nat. Hist. Soc. 2:69-74. [Correl. between woodpecker occurrence during winter, and storage of acorns by them.]

1902 The migration of birds. Bull. Wis. Nat. Hist. Soc. 2:176-263. [Incl. observations at Lake Forest, Ill.; Beloit, Madison, and other Wisconsin localities. Comprehensive review of the subject, especially as pertaining to the Mississippi Valley migration route.] Earlier article, 2:97-107.

WISCONSIN MAPS

1851 to 1931 [Appendix E. of MARTIN, 1932, q. v., pp. 494-513. A full list with essential information, of maps of Wis. and areas within Wis. Incl. base maps, topogr. maps, geol. maps and folios, native veg. (1882), rainfall and temp. (1882), forests of n. Wis. (1898), soils (1908, 1921, 1926), swamp lands (1915), glacial geol., hydrographic maps of upper Miss. River and Wis. lakes, etc.]

WISCONSIN SOIL SURVEY

[See WHITSON, A. R.—A copy of the index map showing soil maps and bulletins of Wis. areas is also published in MARTIN, 1932, q. v., p. 512.]

WOLF, JOHN, AND HALL, ELIHU

1878 A list of the mosses, liverworts, and lichens of Illinois. Bull. Ill. State Lab. Nat. Hist. 1 (2):18-35. See WILLEY, 1877, 1878.

WOOD, FRANK ELMER

1910 A study of the mammals of Champaign county, Illinois. Bull. Ill. State Lab. Nat. Hist. 8:501-613.

1910 On the common shrew-mole in Illinois. Bull. Ill. State Lab. Nat. Hist. 9:1-13.

WOOD, HARRY WARREN

1916 History of Indiana during the Glacial Period. Ind. Dept. Geol. and Nat. Resources 40:10-43. (1915).

WOOD, JUNIUS B.

1931 Illinois, cross-roads of the continent, with illustrations from photographs by CLIFTON ADAMS, staff photographer, and a special map supplement of Illinois. Nat. Geogr. Mag. 59:523-594. May no.

WOODARD, JOHN

1924 Origin of prairies in Illinois. Bot. Gaz. 77:241-261. Also, Trans. Ill. State Acad. Sci. 16:259-263. (1923).

1925 Factors influencing the distribution of tree vegetation in Champaign county, Illinois. Ecology 6:150-156.

WOODRUFF, FRANK M.

1897 Lake Michigan bird notes. The Auk 14:197-200.

1898 15:61-62.

1905 The prothonotary warbler. Birds and Nature 17:194.

1907 The birds of the Chicago area. Chicago Acad. Sci., Nat. Hist. Surv. Bull. no. 6. 221 pp. Extensive bibl., pp. 196-205.

1907 Rare northern birds near Chicago. The Auk 24:107.

WOODS, JOHN

1822 Two years residence in the settlement on the English Prairie in the Illinois country; a description of the principal towns, villages, etc., with the habits and customs of the back-woodsmen. London. 310 pp.

WOODWORTH, CHARLES W.

1887 Jassidae of Illinois. Part I. Bull. Ill. State Lab. Nat. Hist. 3:9-34.

WORTHEN, A. H.

1866 [Topography of prairie as cause of treeless condition.] Geol. Surv. Ill. 1:9-10. (Also in Econ. Geol. Ill. 1:1882.)

1866 [Soils, timber, and bottom prairies of Randolph, St. Clair, Madison, and Hancock counties.] Geol. Surv. Ill. 1:280 and 294, 297, 313, 327-328.

1868 [Soil, timber, etc. of Jersey, Greene, and Scott counties.] Geol. Surv. Ill. 3:121, 123, 134. [Incl. mention of prairies in Ill. River bottoms, and bald grassy knobs of loess bluffs.]

1873 [Timber, etc., of western Illinois.] Geol. Surv. Ill. 5:251, 253, 266-267, 306. [Peoria, McDonough, Monroe and Sangamon counties.]

1875 [Timber and prairie of counties bordering the Wabash; and Williamson county.] Geol. Surv. Ill. 6:21 (Clark); 22, 30 (Crawford); 37, 44 (Lawrence); 63-65 (Wabash, with list of trees and shrubs by SCHNECK); 74 (White); 113-121 (Williamson). [Mention of particular bottomland or terrace prairies of Wabash valley. Cane-brakes, p. 74.]

WORTHEN, A. H. (AND ENGELMANN, H.)

1868 [Topography and vegetation in Alexander, Union, Jackson, and Perry counties.] Geol. Surv. Ill. 3:20, 31; 34; 58, 82, 83; 84-86, 101-103. [Relation of prairie to post-oak flats; the barrens, covered with tall grasses, trees few or none. Other special types of veg.]

WORTHEN, A. H., AND OTHERS

1866 to 1890 [Descriptions of geology and physical geography of counties and other areas of Illinois. Publications of the original Geological Survey of Illinois, vols. 1, 3 to 6, 8. Contents detailed in list of publications of the State Geol. Surv. 1933:24.

1882 Economical geology of Illinois. Reprinted from the original reports of the Geological Survey, with additions and emendations. Springfield. 3 vols. 541, 615, and 596 pp.

See also BANNISTER, H. M., BRODHEAD, G. C., ENGELMANN, HENRY, AND SHAW, JAMES.

WRIGHT, G. F.

1890 The glacial boundary in western Pennsylvania, Ohio, Kentucky, Indiana, and Illinois. U. S. Geol. Surv. Bull. 58. 112 pp.

1918 Explanation of the abandoned beaches about the south end of Lake Michigan. Bull. Geol. Soc. Am. 29:235-244.

WRIGHT, HERMAN P.

1932 Aquatic mollusca of the Tippecanoe River system. Part I. Post-glacial migration and present distribution of four species of snails. Ecol. Monographs 2:233-259. See SIMPSON, 1896.

WRIGHT, JOHN S.

1898 Notes on the cypress swamps of Knox County. Proc. Ind. Acad. Sci. 1897:172-175.

YUNCKER, T. G.

1921 A list of Indiana mosses. Proc. Ind. Acad. Sci. 1920:231-248.

1922 [Additions and corrections to this list.] 1921:155-156.

ZETEK, JAMES

1920 The Mollusca of Piatt, Champaign, and Vermilion counties of Illinois. Trans. Ill. State Acad. Sci. 11:151-182. (1918).

ZIEGLER, E. A.

1904 Natural timber of northern and central Illinois. MSS. U. S. For. Serv.